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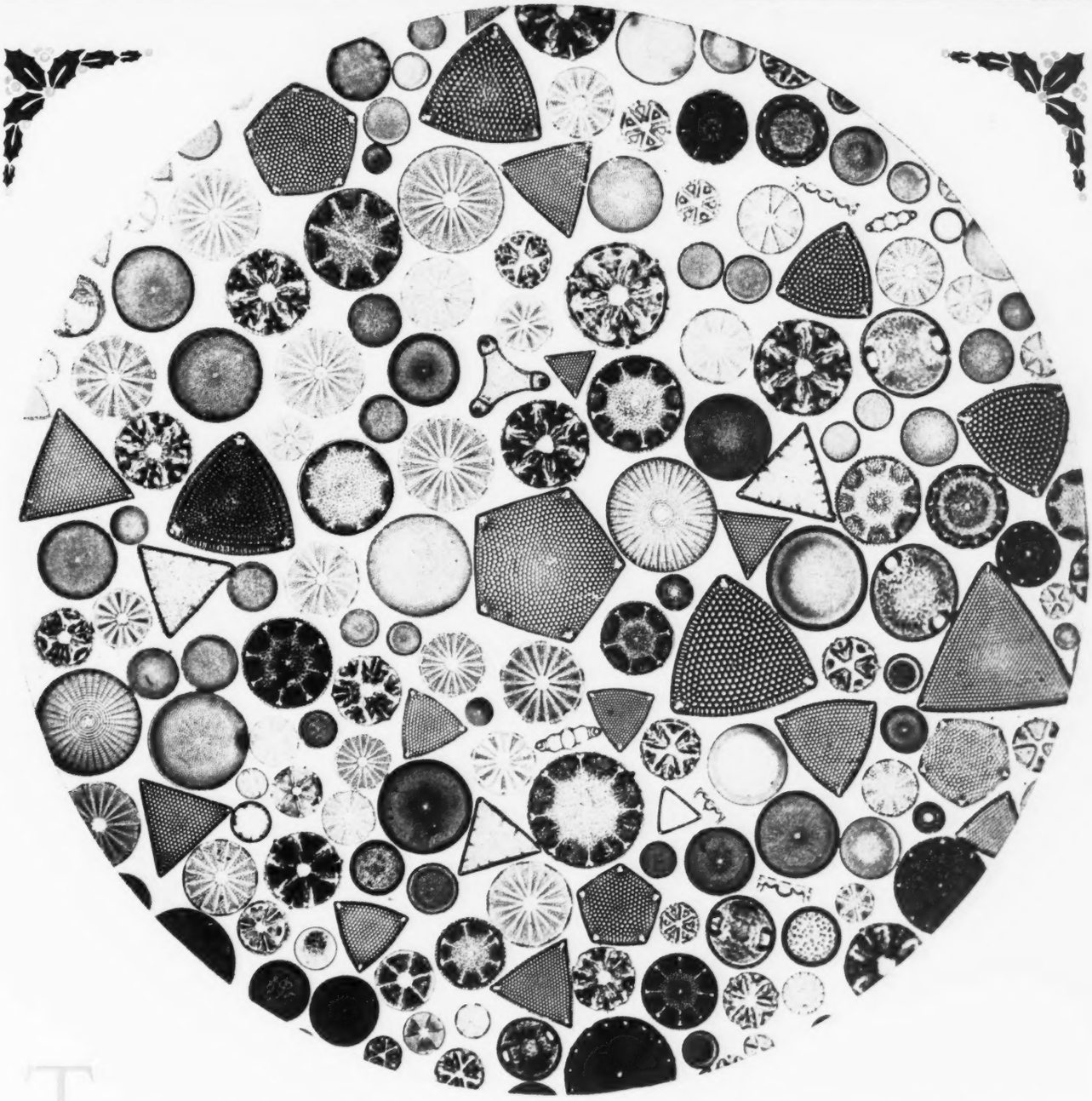

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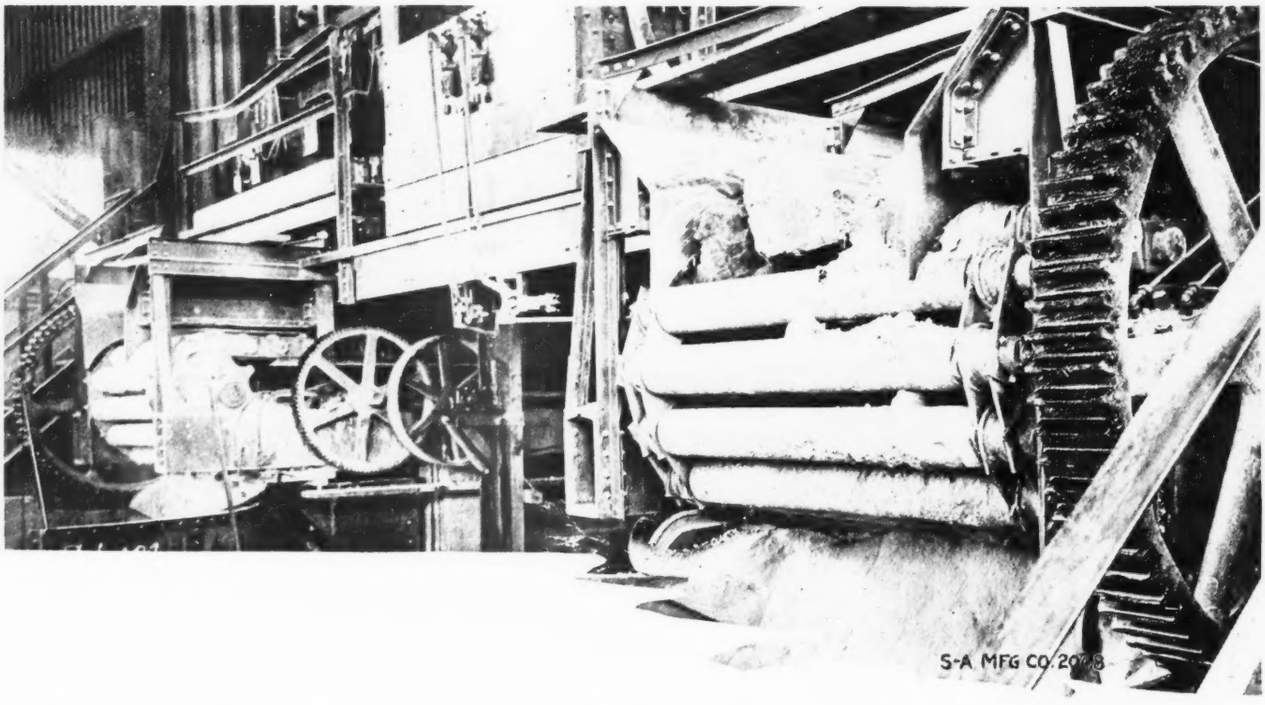

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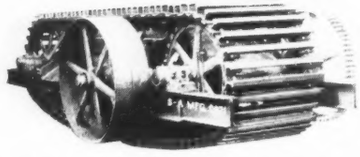

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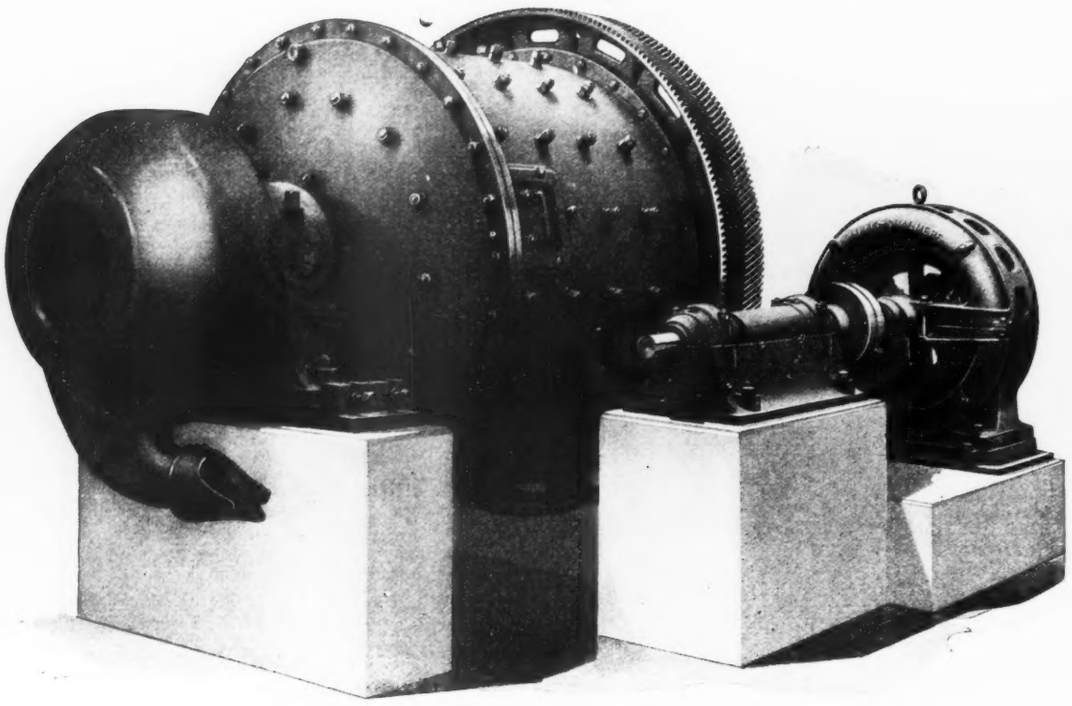

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ENGINEERING AND
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McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

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Engineering Genius in Its Highest Application

AMID the shouting of acclaims and the tumult of recent events one quiet, unassuming, self-effacing man has gone about his country's business with the same dignified efficiency that marked his great work in those tragic days of a decade or so ago when panic ruled the world—Herbert C. Hoover, mining engineer, and in the truest sense a public servant. The tragedy that floods brought to the people of the United States during the year now closing would have been more appalling but for the knowledge that, with the great resources of men and money at his command, Secretary Hoover provided every possible help to the stricken peoples and regions that the country, under his guidance and through its representatives, the Red Cross, and every private agency of relief, found it possible to give. Now that "the waters that prevailed exceedingly upon the earth" have receded, and those who suffered are beginning to take up the burden of normal life once more, the nation will rejoice that one is aiding and directing whose courage, wisdom, and engineering skill promise the ultimate that a sympathetic handling of the task of reconstruction makes possible.

The attributes of genius are past the understanding of man; but its works and the results that flow from them are susceptible of analysis. Those manifestations of superior quality in mind that illumine the pages of human history had, until contemporary time, reflected conspicuous attainment in the realms of art, literature, war, and politics. In 1914, amid the apprehensions and horrors of the early days of the war, the world first learned, overnight as it were, of a new type of engineering genius—that of service to humanity, raised to superlative degree and inspired and activated by the highest of ideals, by a trained and keen technically inclined intelligence, and by a will that acknowledged no obstacle to the attainment of its objective.

Despite his translation to a more influential field of national prominence, Secretary Hoover remains, and always will remain, an eminent engineer—one who applies creative thought and humanitarian considerations to the solution of a problem or to the conduct of an enterprise.

A New Salient in Canada's Mining Frontier

WITH the purchase of the Flin Flon property by the Whitney interests and the construction of a railroad into the region north of The Pas, a new salient is established in Canada's frontier of active mining development.

Accurate appraisement of the ultimate possibilities of the region are, of course, impossible at present, owing to the limited amount of development work that has been performed. The results to date of such work at the Flin Flon and Sherritt Gordon properties alone, however, are sufficiently important to warrant the statement that, if all the projects now under consideration for the development of the area are completed as planned, the region should soon become one of the Dominion's foremost mining districts.

The conclusion of the negotiations between the Flin Flon operating interests and the Dominion, Manitoba, and Saskatchewan governments, which led to the construction of the railroad and the proposal to erect a smelter at the mine and a hydro-electric plant at White Mud Falls as a power source for the area, is significant in that it indicates a readiness on the part of all three governments to aid in the establishment of the mining industry in the Canadian Northwest. Under such conditions of co-operation it is safe to predict that Canada's mining frontier will continue to push northward and that the industry in the Dominion will maintain its recent rapid rate of growth.

When Is a Byproduct?

WHEN a company produces or manufactures one or more major commodities, and, as an incident to these operations, makes a secondary or additional product, the latter is said to be a byproduct. It may fairly be assumed that under normal conditions the enterprise would be profitable even if the byproduct were not made. It is in the nature of a bonus—"velvet," as the card player would say, or a *llapa* among those to the south who use the more expressive Spanish tongue.

Cerro de Pasco always has been regarded primarily as a copper mine. If the income from silver and gold be credited to copper production, Cerro de Pasco has the lowest production cost of any company in the world. If the available data for 1925—the best of recent years so far as earnings are concerned—be analyzed, the following approximate figures are derived: copper produced was valued at 11 million dollars; silver, at 11 millions; and gold, at 1 million. The cost of operation, exclusive of depletion and depreciation, was 13 million dollars, as nearly as can be estimated. It appears, therefore, that if silver and gold are credited against copper production the cost is about 2½c. per pound. On the other hand, if copper and gold are credited against silver production, silver costs about 12½c. per ounce. In either event a highly profitable mining operation! On the other hand, if it be assumed for the sake of the argument that *either* the silver or the copper had been absent from the ore, or had by some mysterious maneuver completely eluded

the metallurgists, Cerro de Pasco would have ended 1925 with a large figure in red ink on its profit-and-loss ledger. In other words, it is hardly accurate to class the company either as a "copper" producer or as a "silver" producer. A better term would be "copper-silver," just as the adjective "lead-silver" is used to define many of the bi-metal mines in the Rocky Mountains.

Another case in point is the American Potash & Chemical Company, which operates at Searles Lake, in California. Current output is more than 200 tons of high-grade muriate of potash and 100 tons of borax a day. Incidentally, at this rate the production of potash is about 15 per cent of the total used in the United States, and that of borax is more than half of the total consumed in the world. Borax is quoted at 4c. a pound and potash at about 1.8c. Consequently, the income from each is about the same, with the margin slightly in favor of borax. If the potash be regarded as a byproduct, the company doubtless is producing borax more cheaply than it ever has been produced anywhere at any time in history. If, on the contrary, there were no production of potash, the company would be in much the same plight as Cerro de Pasco if that company's silver production were to cease.

It is hardly just to relegate either silver or potash to the position of a byproduct when they stand shoulder to shoulder with copper and borax as sources of income to the respective companies.

Copper Queen's Industrial Leadership

AN INTERESTING ANNIVERSARY was celebrated recently at Bisbee, Ariz. It marked the completion of six years' experience in co-operative control and direction of a great industrial enterprise. In July, 1921, the Copper Queen Branch of the Phelps Dodge Corporation initiated a novel and, to some, a radical experiment. Management and men united in the formation of an Employees' Representation Plan, modeled on the pattern of the Congress of the United States, with a House of Representatives and a Senate, the members of which were chosen by secret ballot. The resolutions, the adoption of which created the Plan, provided that not alone were the employees empowered to "pass such measures as may be necessary to the peaceful settlement of all differences arising between the employees and the company," but under the terms of the constitution of the organization the employees might also regulate the hours of labor and the wage scales.

That the unique and "socialistic" testing of the intellectual and moral fiber of Copper Queen's force was successful is evident from the statement of Mr. H. C. Henrie, manager of the Labor Department, at a meeting held recently, on which occasion he addressed the company's employees at Bisbee in part as follows:

> "Today's meeting of the House of Representatives marks the sixth anniversary of the formal establishment of the Employees' Representation Plan, since just six years ago this month the first regular meeting of the House of Representatives was held. At that time the Employees' Representation Plan was looked upon as an experiment and very few plans of this nature existed in the industrial world. The Copper Queen Branch may be regarded as one of the pioneers in this movement, which has for its object the establishment and maintenance of satisfactory relations between the employees and employer.
>
> "Today there are over 1,000 industrial concerns employing over 1,000,000 workmen who operate under some form of Employees' Representation. One of the objectives of American industry during the past ten years has been to establish friendly relations between capital and labor, and I think it is evident that the Management of the Copper Queen Branch has made an honest and sincere effort to accomplish this end.
>
> "Today Employees' Representation is generally regarded as the best means for bringing about better industrial relations in industry. The transactions of the Employees' Congress during the past six years have proved to be wonderfully educational to all of us. There exists today a better knowledge of Company affairs and operations, a better appreciation of the difficulties and problems arising during a period of years in which the selling price of copper reached the lowest point in the history of the industry. Many erroneous ideas and illusions concerning the policies of the Company and its affairs have disappeared, and today the average employee has a much better appreciation of the problems confronting the Management, and a broader viewpoint on industrial questions in general. I think I can state without fear of contradiction that both the Management and the employees are agreed that the Employees' Representation Plan has been mutually beneficial to both the Company and the men."

That the Phelps Dodge Corporation and the Bethlehem Steel Corporation, which has operated under co-operative management for nine years, should be leaders in the movement to bring about a better understanding between management and employees is significant of the type of mind dominant in the respective industries represented by these corporations—the engineering, analytical, searching intellectual quality that finds in obstacles only an incentive to accomplishment—the type that solves problems.

Beyond calculation are the benefits that accrue as a result of co-operative efforts to create safe working conditions and to prevent accidents when such efforts take the form that characterizes conditions at Bisbee. These benefits are reflected in improved morale—which is synonymous with efficient and profitable management and operation.

To each of Copper Queen's employees is delivered monthly a copy of the "Copper Queen Bulletin," which, according to a statement on the cover, is "Published in the interests of the employees of the Copper Queen Branch." The Bulletin is notably interesting, not alone in its relation to the social and industrial life at Bisbee, which it duly chronicles, but because it affords material for study by all executives who find labor somewhat refractory, which is usually attributable to the fact that the executive machinery responsible for its treatment is not competent for or appropriate to its task. The Bulletin is recommended as a primary textbook in "human engineering" for any executive who is conscious of the need for improvement in relationships within his organization. Trouble with labor, difficulties with labor-union officials, organizers, or "delegates," can usually be obviated by the amelioration of conditions that, from time before the Pyramids were built, have resulted in the creation of guilds, unions, cults, and "orders."

Copper Queen and Bethlehem Steel have proved the practicability and justified the objectives of the Employees' Representation Plan. It promotes solidarity, unity, and understanding. With such modifications as circumstance may determine to be expedient, its further adoption and extension may be recommended to executives in every department of the American mining industries.

Ambassadors Three

AT THE MOMENT the cream of the ambassadorial staff of the United States is on the job in a neighboring country, accomplishing what may be styled—for want of a better term—"wonders." Mr. Morrow, the official representative of the United States to Mexico, undertook his new duties as ambassador only a few months ago. With his broad business training and with a few competent moves in the chess-like game of diplomacy, he soon established a plane of accord between the two countries. The stage was set for the appearance of the second member of the Ambassadors Three—Will Rogers, self-styled "ambassador without portfolio." Mr. Rogers enlarged the plane of accord to one of human and interesting understanding. But it remained for the third ambassador, also an ambassador without portfolio, but one bearing his title by national and international acclaim, to add the close international personal touch—the goal of ambassadors, the indefinable something that carries with it the spirit of mutual concern and good will between nations. Colonel Charles A. Lindbergh did it again—once more not only accomplishing a most difficult aeronautical feat, but also establishing between two countries a sympathetic spirit of good will that should be on the friendliest of terms.

From this point to the mining industry is quite a step, but the thought sequence is logical enough. In the formation of an international spirit of good will between Mexico and the United States, the possibility of the recurrence of many of the trying episodes experienced by mining companies in Mexico in the past should be avoided, to the mutual benefit of the interests of both countries. To the Ambassadors Three, the mining industry owes a debt of gratitude.

Efficiency and Economy in Technical Publication

FAVORABLE COMMENT is heard in reference to steps taken to give prompt and adequate publicity to the noteworthy paper on "Geophysical Prospecting" read recently at a joint session of the American Institute of Mining and Metallurgical Engineers and the Mining and Metallurgical Society of America, by Dr. Max Mason, president of the University of Chicago. The meeting took place on the evening of Oct. 27. *Engineering and Mining Journal,* realizing that a service to all concerned could be performed, opened immediate negotiations with the officials of the two societies and the author of the paper. At the conclusion of these negotiations, on Oct. 31, preparation for publication was begun. The pages for the first installment went to press, with six illustrations, on Nov. 7, the complete issue being mailed to subscribers on Nov. 10. The second and final installment, with not fewer than fifteen line drawings, appeared in the following issue, that of Nov. 19.

Engineering and Mining Journal is only too willing to co-operate in giving the paper further publicity. Five hundred reprints have been made for the personal use of the author of the paper; and a duplicate set of cuts has been provided, for the Institute and the Society. We are asked to announce that the Institute is particularly anxious to encourage full discussion of the paper and the entire subject of electrical prospecting prior to the annual meeting to be held in February.

This example of co-operation will suffice to indicate the opportunity that exists whereby *Engineering and Mining Journal* can serve the industry and the societies by utilizing its editorial and production facilities and by shouldering the expense of prompt publicity and wide distribution of important papers. It indicates, moreover, a signal advance in efficiency and economy achieved by the adoption of a helpful and co-operative spirit on all sides. The time for competition that merely enervates is passing, but the idea of taking any action not in the best interests of all concerned is displeasing to us. We feel, however, some degree of responsibility in the efficient and the effective conduct of the affairs of the Institute. Contrary to current opinion, even among high officials of that body, the first meeting to plan the formation of a society that now holds so high a place in national affairs was staged in 1871 in the editorial sanctum of *Engineering and Mining Journal.* The plea for the substitution of co-operation in place of wasteful competition is not unmixed with a sentiment that springs from a realization of parental responsibility.

More and Better "Personals"

THAT the Personal and News pages of a magazine such as *Engineering and Mining Journal* are among its most attractive features is a fact frequently attested. Even two pages devoted to personal notes, as is sometimes allotted, is none too much if the items are about people that many readers know, or are otherwise of interest. But there are several kinds of Personals; the best kind tell of changes in employment: if any of our readers are promoted to a better job, or sever their connections with one company to go with another, that fact deserves mention, and the person in question owes it to himself, and to his friends who are likely to be in many parts of the world, thus to keep them advised of his movements. Announcement of serious illness or accident or recovery therefrom, is usually interesting, as are also marriages, particularly if the benedict is one for whom his friends had little hope or fear, as the case may be. Of somewhat less interest are items concerning professional trips, though these may be of special value if announcement is made before the actual trip takes place. It is generally assumed that consulting engineers, with the exception of those who are starving to death, make fairly frequent trips of inspection, so it would seem well to report only those of particular importance, or to little-known districts. Near the bottom of the scale of desirability are items from those professional publicity seekers who cannot bear to take a vacation without having their names in print.

All too often engineers receive no consideration when promising opportunities occur because nothing is known of their present whereabouts or of their specialized experience. An occasional personal mention therefore serves a professional as well as a social purpose. In changing his address on our circulation files, the reader is urged to say a word or two about himself, with the request that the Editor's attention be called to the matter. Or if the reader is not a subscriber to *Engineering and Mining Journal,* or has an item of personal interest that does not involve a change in address, a brief note to the Editor is all that is necessary.

A Christmas Letter

From Alfred James

THIS is the Twenty-fourth Annual Supplement carrying out my suggestion in "Cyanide Practice" that I would be happy to send to members of the Cyanide Club an annual letter at Christmastide in return for their letters of progress, of difficulties overcome, and of failure. Not all these letters have been technical; during the war they dealt with war work, but, such as they have been, they represent with "Cyanide Practice" twenty-five years of succeeding effort and have involved, apart from the printing of "Cyanide Practice" and of the letters in various journals over the world the typing and mimeographing of more than 16,000 sheets of foolscap.

The recent Empire Mining Congress has evoked such good will among mining men, as a result of the boundless hospitality and perfect carrying out of well-laid plans, that we may expect the advertisement Canadian mining has thus received to react favorably on the consideration given by investors to future propositions emanating from that territory. The technical methods employed have been quite as fully appreciated. Outstanding impressions have been the extraordinarily able metallurgical engineering at Trail and the remarkable possibilities of the Sudbury district. Indeed something of a boom in the shares of the leading concerns of the latter district seems to have set in during and since the Conference.

Teck-Hughes Flow Sheet—To me, however, the outstanding satisfaction has been the appearance of the Teck-Hughes flow sheet (*Engineering and Mining Journal*, Sept. 17, 1927, p. 469). For years the practice at Porcupine has made me despair: of what use had been the working out of experience over the world if Canada set her face against benefiting by it and was resolved to repeat on a huge scale pioneer efforts already relegated to obscurity in other districts of the world?

AT ONE well-known mine a large mill was erected and, if my memory serves me aright, within a year we were informed an entirely new mill was necessary. More recently the flow sheet of a new mill in another district, brought to me triumphantly by a not too well-informed admirer, showed ineffective agitation plus a bulk of circulating solution too vast for precipitation, with no effective safeguards against the mingling of washes which remained unfiltered.

What could I do? Only hang on and hope, and endeavor by these letters and by personal influence to awake a return to sounder practice.

The new flow sheet shows that gone are the days of countercurrent-agitation-without-filtration, originally suggested by George Moore as a method for the separation from sand of oxidized or rapidly leachable slime and its treatment in one apparatus.

As I have previously pointed out in these letters, South African decantation was evolved to a very high degree; it had the merit of applying washes separately in measured quantity, but even with this safeguard the bulk of solution in circulation was uneconomic. An even greater drawback was that in spite of the frequent agitation through centrifugal pumps, and a slow swirl in huge vats, solution was ineffective and appreciable valuable mineral was rapidly dissolved by fresh solution after filtration. The coming to the Rand of the Vacuum filter and the Brown agitator numbered the days of decantation as an up-to-date, economic method of slime treatment there. Australia, India, and America never really adopted it—and yet in face of this experience Ontario was content to rely on countercurrent agitation.

The new flow sheet of the Teck-Hughes company would appear to go to the other extreme. It looks as though after an experience of a lack of effective agitation of the ore and of effective separation of the washes the designer was determined to accomplish really effective agitation and filtration by the introduction of these in series. The designer avoids the previous huge bulk of circulating solution, but if the agitator is effective why repulp and re-agitate at more than double the cost? It would seem to take us back to the days of African inefficient pump agitation.

AS A result of the treatment of really refractory ores at Waihi and Kalgoorlie, a practice was developed which has been adopted over the world and is still the basis of effective practice on really difficult ores: agitation in pachucas and filtration, originally in Dehne presses, and later in vacuum filters. A certain proportion of gold is soluble with relative ease, but the treatment has to be based on the solution of the more refractory portion—why go to the expense of separate treatment for what one should obtain without such extra cost? And why precipitate four tons of solution to one ton of ore? Apart from Kirkland Lake, the most refractory ores I know of that are being successfully cyanided today are the silver sulphide ores of Mexico and Nipissing, the telluride ores of Kalgoorlie treated by roasting or bromocyanide, the graphitic ores of Ashanti treated by roasting for their economic beneficiation, and similar ores in Rhodesia. Many of these ores (Rhodesian excepted) were of even higher content (in ounces of gold or silver) than those of Teck-Hughes and could better afford agitation or filtration in series. Such series treatment has been from time to time experimentally tested, but I have no knowledge of its permanent adoption in practical operations.

On the other hand, if the Teck-Hughes control has reason to fear rapid re-precipitation of gold, this would account for the series agitation and filtration; but the circulation of gold-containing solution from the Marcy through the tube mills and then through the pachucas without intermediate precipitation is against such supposition. One thing is certain: all speak most highly of the technical ability of Mr. Forbes (whom I do not remember to have met personally), and there must be

ALFRED JAMES

sound reasons for the above flow sheet. I hope Mr. Forbes will let us have some account of the ore and of the difficulties encountered in treating it.

IN THE above I have not referred to antimonial gold ores, the treatment of which involves different practice. The reference to refractory ores brings me naturally to the constant endeavor to facilitate the beneficiation of these by the application of selective flotation for the separation of portions requiring long treatment or containing extra refractory particles. Flotation has proved itself eminently successful where it is a question of pounds and hundredweights per ton, but is it not expecting too much of it to expect it to worry about grams or even pennyweights?

In addition to that from Teck-Hughes, flow sheets have come to me during the year from Africa, Mexico, and Westralia: all apparently have one idea in common—the endeavor to avoid stamps. I will refer first to that of Carl Davis *et al.*, who have been making history in South Africa by their work at Springs mines. It is somewhat extraordinary that the publication of their original paper should have provoked so poor a discussion (New York meeting A.I.M.E., February, 1925). A comparison with the vigorous and full discussion on H. S. Ball's paper (*I.M.M.*, Vol. XXI) will emphasize what I mean. Is it that New York is the place for good papers and poor discussions? And yet Davis's paper was deserving of full discussion, not only for the courage of his practice in introducing a new system on the Rand, but for his overriding of accepted conclusions as to the amount of angular rock used as "pebbles" and the large size and huge tonnage of the pebbles rejected (for re-crushing) as useless. A reject of over 25 tons of pebbles per diem per tube mill (22 ft. x 5 ft. 6 in.) is rather an eye-opener.

DAVIS showed that he could obtain extractions from material crushed without stamps, but at a cost in power. In other words he produced without stamps 0.854 ton of minus-90 mesh per hp.-day, against 0.9025 ton with stamps and tube mill. But Davis was crushing the difficult intermediate material, the quartz sand, finer than before; hence his success, even though the analyses showed less very fine slime than that characterizing the previous standard.

Davis demonstrated that his material crushed at 71.4 per cent through 200 mesh yielded a better extraction than the former standard method yielding 77 per cent through 200, the gain being from the finer crushing of the intermediate sand at a cost of 20.15 kw.-hr., or $1\frac{1}{8}$ hp.-day. Ultimately we expect him to make economies, apart from a change in crushers, as by the introduction of a better fitted pulverizer than the fine-sliming tube mill—e.g., a Marcy mill between the crusher and tube mill, and with it a return to 77 per cent minus 200 at a cheaper cost. But the toughness and hardness of gold ores in Africa, India, Westralia, and New Zealand are found to cause a very high consumption in steel in ball mills used for wet crushing, and it is undoubtedly this heavy wear of metal which hinders the adoption of what otherwise appears so suitable an appliance. As it is, Davis gains a better extraction with a more simple and less costly plant.

The Davis results are affecting mill practice in the Rand even where stamps are not displaced. Thus at the West Rand Consolidated the mill with 100 stamps is to be brought up to deal with 3,620 tons per diem, of

which 545 tons are sorted as waste, 435 tons screened for tube-mill pebbles, 1,130 tons screened to minus 2 in. go to the stamps, and 1,335 tons direct to tube-mill plant, the 175 tons minus 200 washed-out slime going direct to classifier.

THIS elimination of fine slime from the crushing, pulverizing, and sliming plant by washing is a very noticeable feature of African practice, and was well brought out by Bosqui in his paper. So far as I know it was first put into practice by J. T. Marriner, of West Australian fame, at Pahang Consolidated; he was very enthusiastic over the gain thus obtained from the avoidance of the choking of his crushers and pulverizers by material already slimed.

Crushing—The feature of the year has been the introduction into practice of the Symons cone crusher. The large reduction ratio of the horizontal disk crusher is well known, as is also the great success attending the use of the vertical disk crusher, with its finer output: the advent of the cone crusher naturally created more than usual interest. It first came to my notice when being installed in one of the great silver plants of Mexico. The point which particularly struck me was the proposed large ratio of reduction in one step, 5 in. to $\frac{3}{8}$ in., with 60 tons' hourly output for 65 hp. It was proposed to scrap four gyratories, replacing them by two 4-ft. cone crushers, in the hope that the improved reduction would permit of the scrapping of the stamps and save approximately $5,000 (U. S. currency) monthly—no small anticipation from the adoption of two new comparatively small machines.

Writing three months later, my correspondent states that these cone crushers are a complete success when not required to handle wet, sticky ore—the clearance between bowl and cone for $\frac{1}{2}$-in. product being too small for wet material. He is enthusiastic over results. The installation of the two 4-ft. machines has knocked off a shift in the crushing plant, and shut down two-thirds of the stamps, at a saving in cost of $6,000 a month.

My correspondent appeared rather optimistic in expecting a 5-in. to $\frac{3}{8}$-in. reduction—$4\frac{1}{2}$ in. to $\frac{3}{8}$ in. would have been more in accordance with makers' estimates for the output required. He has certainly cause for great satisfaction with his results and the money gain resulting therefrom.

TO A critical examination the cone crusher appears a remarkably well-designed apparatus, with several novel features—the springing of the head to avoid fracture from tramp iron is a case in point. The greater flare given the conical breaking head and the increased impacts resulting from the concaves diverging downward, at times almost parallel with the cone, must throw extra strain on the shaft, increased by the leverage resulting from the carrying on of the cone head beyond its solid backing. If this is so we may confidently expect such strains to be effectively provided for in the next pattern placed on the market. The people who have brought disk crushers to so successful a point are best qualified to make their cone crushers quite as strong and even more successful.

In private letters I have mentioned that a well-known mill in Mexico had made a gain of 8,000 tons per month, at a cost of 45 hp. only, by adopting a Symons vertical disk crusher. In the interests of the profession it might be well to expand my former note, which I am enabled to do by the courtesy of Mr. C. E. Moore, consulting engineer to the United States Smelting, Refining & Mining Company, and Mr. M. H. Kuryla, vice-president and general manager of the Real del Monte Company, at Pachuca. The disk crusher was installed between the secondary gyratories opened up to give a 3-in. to $3\frac{1}{2}$-in. product, from which minus-1-in. material was screened out. The vertical disk takes care of the 3-in. feed, crushing it down to $1\frac{1}{4}$ in. at the rate of 75 tons per hour using 40 to 45 hp. A set of disks proves good for about 125,000 tons. It can be set to give a $\frac{3}{4}$-in. product at the rate of about 60 tons per hour.

IN SPITE, however, of the great success of this modification there is to be no standing still. Something very attractive is embodied in the suggestion to displace gyratories and even Marcy mills by "one easy step." In practice this "one easy step" is usually found to have a drawback—the constant tendency to make a machine attack a greater range of reduction than its most efficient limit. Stamps and tube mills in gold milling are instances of this. Until "all-sliming" demanded a fineness unattainable by stamps, the practice had developed to use finer and finer screens in the attempts to keep pace with improvements in cyanidation. Now, conversely, tube mills using 1 hp. per ton are being asked to grind even 2-in. material that one would expect could be crushed more cheaply by impact. We cannot give a greater range to gyratories and breakers, because it has been found that economic crushing by such means is severely limited by questions of wear and tear and clearance; thus we cannot expect a reduction of more than 8:1, and in general practice 6:1—i.e., 12 in. to 2 in., $9\frac{1}{2}$ in. to $1\frac{1}{2}$ in., 6 in. to 1 in., etc.—would be more usual ratios. But Symons specifies a cone crusher to crush in one step 330 tons per hour of 10- to 12-in. material down to $\frac{3}{4}$ in. for 150 to 200 hp., depending on the hardness of the rock. Let us look at this. Originally the Loretto mill consisted—apart from the stamp section—of

Two primary No. 6 gyratories	=	70 hp.
Two secondary No. 6 gyratories	=	70 hp.
Two 8x6-ft. Marcy mills	=	450 hp.
Total		590 hp.

for 1,000 tons a day through $\frac{3}{16}$-in. mesh.

With a $1\frac{1}{4}$-in. feed the output of the Marcy increased to 750 tons a day each, so that their new power sheet is

Two primary gyratories	=	70 hp.
Two secondary gyratories	=	70 hp.
One Symons disk	=	45 hp.
Two Marcy mills	=	450 hp.
Total		635 hp.

for 1,500 tons a day through $\frac{3}{16}$-in. mesh.

NOW, Kuryla has proved that the Symons disk will output 60 tons per hour of $\frac{3}{4}$-in. mesh material. We thus have four gyratories, 140 hp., plus one Symons disk, 45 hp., giving us 1,440 tons per diem, $\frac{3}{4}$-in. mesh, for 185 hp. The Symons cone is claimed to give the same duty for 150 hp., a saving of 35 hp. At the Chino the cone crusher delivers 280 short tons per hour crushed from 10 in. to $\frac{3}{4}$ in. for 125 hp. The feeding of the resulting material to rod and tube mills in parallel or series—the coarse material going to rod mills—is now accepted Mexican practice. At the Mexican Corporation a 6x12-ft. rod mill grinds 0.097 ton per horsepower-hour of new feed (30 per cent plus $\frac{3}{4}$ in.) down to $17\frac{1}{2}$

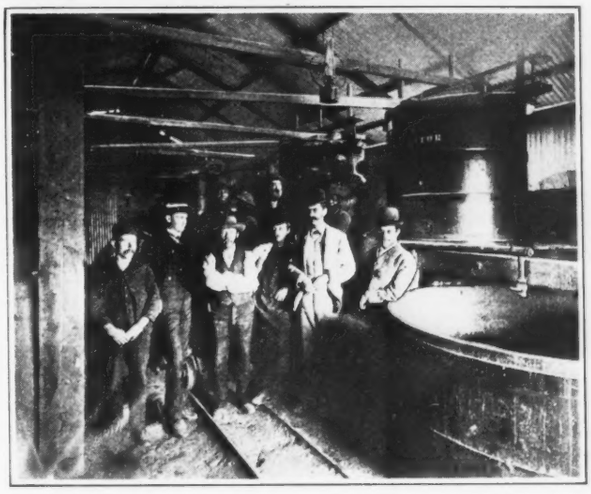
per cent plus 100 and 61 per cent through 200 mesh. If this is fine enough, then total reduction to 61 per cent minus 200 can be effected for about 330 tons crushed for 165 horsepower-hour and slimed for 0.097 ton per horsepower-hour, giving a total of 3,588 hp.-hour or *10.9 hp.-hour per ton crushed and slimed.* If greater fineness is required, tube mills would be used for the plus-200-mesh particles at a yield of only 0.035 ton per hp.-hour for a fineness of 75 per cent through 200 mesh.

From the above it is obvious how vast is the consumption of power for sliming as contrasted with that for reduction from 12 in. to $\frac{3}{4}$ in. or even $\frac{1}{2}$ in. The rod mill appears to offer a considerable saving by taking from the tube mill the coarse crushing for which the rod mill appears better adapted. The economic limits of the rod mill are 1 in. to $\frac{1}{50}$ in., and it is a question worth testing if a Marcy mill would not be better than a rod mill for breaking down the $\frac{3}{4}$-in. product to say 10 mesh, leaving to the tube mill its original duty of grinding minus-$\frac{1}{8}$-in. particles. If Fresnillo consumption be taken to be 18 hp.-hour per ton slimed to 61 per cent minus 200, and that of Real del Monte as 24 hp.-hour for 75 per cent minus 200, it would appear possible that the adoption of the rod mill for a portion of the Real del Monte grinding might reduce the power consumption to 21 hp.-hour per ton.

IN WRITING of crushing, one has to refer to Professor Raymond's recent work on the comparison of hardness of ores. Some standard of hardness and toughness is needed which will enable one to judge the performance of a machine at Chino so that the record can be translated into terms of duty at Waihi or Mysore. Raymond adduces percentage of silica present as a measure of hardness. I have often wondered whether I should give pure quartz or Cornish "capel" the first place. A rough scale has formed itself in my mind, perhaps corresponding to geological age; I place first, ores of tin, then of gold, after these come those of copper, lead, and zinc. A rough and ready approximation is afforded by the excellent tables in Taggart's "Ore Dressing," from which one may perhaps infer, for example, that a duty of 0.2 ton per horsepower-hour at Chino is the equivalent of 0.05 ton at a particularly tough proposition.

I cannot resist the temptation to refer to Taggart's book. It is what we have all wanted and never had! I wrote my "Cyanide Practice" and my Christmas Letters to record data useful to me in my work; I circulated these as a return to the profession for the details of technical work being sent me from far and near. Having introduced the cyanide process into South Africa and applied it successfully to the treatment of tailings, I was not content to let it go at that: year by year I circulated records of improvement and also of failure, so that we all might benefit by the one and avoid the other.

AND now Taggart comes along absolutely up to date, with painstaking completeness of detail for comparison; and to cap all he gives us courageous, balanced judgments on the merits of competing devices—judgments of the highest potential value to us all. I tell you we all have to get and ponder over that book; I hope Professor Taggart will be encouraged to keep it absolutely up to date. We in gold mining have been discouraged at every attempt to use rolls: we are informed that our ores are too hard and that rolls will not crush sufficiently fine: but as I reread Taggart (p. 313, line 25) I am led to wonder if heavily built rolls will not prove the answer to my problem as to the best crusher to take care of $\frac{3}{4}$-in. cubes of quartz with the economic limit of size of output. The old stamp has done its work well, but at what a power cost—a duty of 0.07 or even of 0.14 ton per horsepower-hour is too much like the cost of rod milling to be acceptable for impact crushing. Of course, if the Symons cone crusher will crush cubes of solid quartz to as fine a point as the makers claim—minus $\frac{1}{8}$ in. —then we have arrived at what we seek, but I have no word from anywhere that these results in fine crushing have been established in practice. But Symons has been as good as his word before, and I certainly have the hope and expectation that practice will confirm his statements. We should then have 600 tons per hour crushed from 11 to 12 in. down to $1\frac{1}{2}$ in. for 200 horsepower-hour, and 86 secondary cones taking the $1\frac{1}{2}$-in. product and delivering it at tube-mill size, $\frac{1}{8}$ in., for a further 1,720 horsepower-hour, or 600 tons crushed and ground from 12 in. to $\frac{1}{8}$ in. for 1,920 horsepower-hour, or 0.3 ton per horsepower-hour,—three times the average duty per stamp on this work. If for the purpose of comparison we make the final cone product $\frac{3}{8}$ in. to compare with the results of Nissen and standard gravity stamps at City Deep, we get 600 tons crushed from 12 in. to $\frac{3}{8}$ in. for 1,000 horsepower-hour, or 0.6 ton per horsepower-hour, against 0.3 ton by Nissen and 0.2 ton by gravity stamp crushing only from $2\frac{1}{2}$ in. original maximum.



The Salisbury demonstration plant in 1900

From right to left: Alfred James; J. S. MacArthur; G. Mason, an assistant from the Glasgow laboratory; F. Inglis, in charge of the erection of the vats, and later one of the shiftmen; W. A. Caldecott; W. Titmus, in charge of erection details and later a shiftman.

Graphitic Ores—During the year I have made special enquiry as to methods and results in the treatment of graphitic ores. The reversion of the Ashanti Goldfields to roasting and dry crushing has regained their former good extraction, and the question asserted itself with some urgency: Are we compelled to roast graphitic ores or can we rely on some other method of beneficiation such as pre-oiling, to which our attention was called some time ago by Denny's work in Ontario?

I wrote to various parts of the world where graphite is a menace to gold extraction—to Chosen, to West Africa, Rhodesia, Ontario, California, Western Austra-

lia: it seemed to me graphitic ores were being mainly "treated" by their absolute avoidance. Apart from the roasting method of the Ashanti Goldfields, I could find no successful treatment. E. M. Hamilton, so widely known for his good work with Butters, impressed me as having tackled the problem of treating unroasted graphitic ore more seriously and more successfully than any other engineer, and I hope he will be persuaded to publish his results. Meanwhile he gives me the impression that pre-oiling is no cure, but merely an alleviation of the malady. Is there hope for effective aid from flotation? I feel in this matter the application of the legal maxim *"De minimis non curat lex."* The gold content of 10-dwt. ore is just one sixty-five-thousandth of its weight.

If, then, roasting is at present our only hope, by how much—if at all—will our costs be increased? This question set me hunting up old records of costs. How stand old records in comparison with the higher cost of labor, supplies, and of taxation today? On the other hand, roasting undoubtedly saves crushing just where it becomes most expensive—in sliming to pass 200 mesh. It was noted during the competition of pans versus tube mills at Kalgoorlie that the ultimate fineness required for final extraction was not nearly that essential with unroasted ores, whether tellurides at Kalgoorlie, or sulphides at Waihi and Redjang Lebong, or the silver sulphides of Mexico. But, even so, we can scarcely appraise this benefit from roasting at more than ¼ hp. per ton roasted.

HOW, then, does dry crushing compare in cost with wet crushing? Of the great convenience of wet crushing, with its easy water transport and separation of material in process and avoidance of dust, there is no doubt—but what are the figures?

Costs—In its best days I find the Ivanhoe (Western Australia) wet crushed and concentrated for a cost of 8s. 9d. per ton (1905), its lowest total cost being 20s. 10d. per ton treated (1908). This was on a scale of 200,000 tons a year. The Great Fingall, on the other hand, treated by wet crushing and concentration, roasting and grinding concentrates, 260,000 tons a year for a total cost of 18s. 11d. per ton, of which treatment came to 7s. 1d. (Breaking, 4¾d.; milling, 2s. 8½d.; grinding, 9d.; cyaniding, 10½d.; filtering, 11½d.; precipitation, 2½d.; balance for concentration and roasting, grinding and cyaniding concentrates.) The Sons of Gwalia, wet milling, costs (1907) were 5s., including breaking, 2½d.; milling, 1s. 10d.; concentration, 1½d.; roasting concentrates, 2¼d.; grinding concentrates, ¾d.; grinding sands, 2½d.; cyaniding, 1s. 1¾d.; cyaniding concentrates, 2½d.; filter-pressing concentrates, ¾d.; precipitation and smelting bullion, 1d.

So, far from roasting being prohibitive, it may even be less costly.

At Kalgurli costs (1906) came to: Breaking, 4¾d.; roasting, 3s. ¾d.; crushing, 1s. 6½d.; grinding, 1s. 8d.; agitating and pressing, 1s. 9d.; total (with roasting), 11s. 1d. for an extraction of 94.5 per cent.

At the Oroya Brownhill (11,000 tons a month wet crushing) breaking came to 8½d.; milling, 1s. 10½d.; grinding, 1s. 5½d.; agitation and cyanide, 4s. 6d.; filter-pressing, 1s. 5½d.; precipitation and smelting, 8½d.; total, 13s. 9d.

Taking the milling costs at Kalgoorlie in 1906 I find the four wet-crushing mines averaged 12s. 7¼d. per ton for crushing and treatment; and the six dry-crushing mines averaged about 2d. per ton less—12s. 5⅓d.

From the above we see that dry crushing is not so prohibitive as we are likely to imagine and that it stands up against wet crushing on equal terms. On comparing these costs with those of the present day I estimated the latter to be at least 25 per cent higher.

The recent cost for roasting at Great Boulder (100,000 tons per annum) was 3s. 8½d. per ton for 1925 and 3s. 10½d. for 1926. In 1906 these costs were 2s. 3d. per ton. The upward tendency still continues.

The present South Kalgurli treatment costs (in 1926 on a 300 tons per day basis) are 15s. 2d. per ton, including dry grinding and roasting. In 1906 these costs were 11s. 3d., of which dry grinding was 2s. 11d.; sliming, 1s. 3d.; filter pressing, 1s. 6d., and roasting, 2s. 6d.

The Lake View & Star treatment cost (425 tons a day basis) in its new up-to-date mill is 12s. 4½d. per ton for 1926. This includes roasting and tube milling.

In the recent government report on mining conditions in the Kalgoorlie field, the Lake View & Star equipment comes in for exceptional praise: through the courtesy of Messrs. James Brothers, the consulting engineers, and of Mr. Vail, the general manager, I have received a flow sheet which shows, apart from sampling arrangements for tributors' ores, that the small proportion of oxidized ore is wet-crushed in ten stamps, passes to two grinding pans, and then joins the main stream of sulpho-telluride ore, which is dry-crushed in six No. 8 ball mills, roasted in six Duplex Edwards roasters, then mixed with circulating solution and, with the oxidized pulp above mentioned, it is pumped to three Dorr classifiers. The sand is ground in three tube mills, the slime is thickened, and, with the dust from the fan chamber at the ball mills, is agitated with cyanide solution and vacuum (leaf) filtered.

This represents the latest and best Kalgoorlie practice, the sequel to and the result of the battles of the processes which used to interest us so greatly—roasting versus bromocyanide, stamps (wet) versus ball mills (dry), pans versus tube mills, and shows how complete has been the victory of the exponents of roasting and tube milling. A paper on the subject from the able metallurgist, Mr. Stevens, would surely be most welcome.

The result, therefore, of my investigation into graphitic ores is that if no better method is available we need not shirk dry crushing and roasting, and that on present known practice the Ashanti Goldfields' board were amply justified in reverting to dry crushing and roasting, as indeed results have proved. That they did not revert earlier is a tribute to their enterprise and courage and to that of their late consulting engineer who, sound and able in his long and successful experience, did not hesitate to seek further improvements in practice. We cannot always succeed, but without such endeavor there would be no progress.

More About Costs—I wrote above that I estimate present costs at 25 per cent above pre-war costs. I am not sure that the appreciation should not rather be 50 per cent. Gone by the board are W. W. Mein's pre-war total costs (including mining and reduction) at the Robinson, South Africa, of 12s. a ton; instead we now have 19s. 10d. per ton for the 7,000-ton-a-day plant at the Crown Mines. The Hollinger total costs for 1925 are 16s. 10d., of which stamping is 9d.; classifying and grinding, 14d.; agitation, 1½d.; and filtration, 7½d.; the latter surely very high compared with the figures given below and with West Springs (Davis) leaf filter at 3.332d. These costs compare with those of Dos Estrellas (Saunders) 1,000-ton-a-day, of milling 2s. 6d., and

cyaniding 4s. 2d. per ton. (See this letter for 1920.) Details are: Crushing, 0.06d.; weighing and sampling, ½d.; stamping, 7d.; tube milling, 1s. 3½d.; classification, 2d.; laboratory, ½d.; thickening, ½d.; agitation, 3¼d.; handling slimes and solution, 3d.; classification, ½d.; filtration (leaf), 4d.; precipitation (Merrill), 8½d.; cyanide, 1s. 8d.; concentration, 0.63d.

The Hollinger consumes in its ball mill plant ⅔ hp. per ton crushed; in its 1,500-lb. stamp mill $\frac{7}{10}$ hp. per ton crushed; and in its 1,625-lb. stamp mill, ¾ hp. per ton crushed.

In South Africa stamps plus tube mills appear to consume over 1¼ hp. per ton crushed. This is ¼ hp. and ½ hp. respectively greater than the Mexican consumption noted above. Davis's latest figures (Empire Mining Congress) show over 1½ hp. per ton, but this includes agitation. Power consumed by the tube mill was 20.15 kw.-hr. on the total tonnage passed through mill.

The treatment cost was: Sorting and crushing, 7.05d.; tube milling, 20.65d.; cyaniding, 8.45d.; filtration, 3.33d.; precipitation, 1.96d.; smelting, 1.04d. A total of 42½d. on a basis of 40,000 tons a month.

WE HEAR all too little and too seldom of the good practice of the Mysore field in crushing and cyaniding. In my notes I find a consumption of ½ hp. per ton for the stamps and rather less for the tube mills, or just under 1 hp. per ton crushed.

Water Consumption comes to 125 gal. per ton treated at the Lake View & Star. This includes all water for treatment, but not for the generation of power and the sluicing of residues. At another mine the water consumption comes to 375 gal. per ton for all purposes, including prevention of dust underground, drilling, hoisting, power and condensing, treatment, horses, domestic drinking, gardens, and other uses. In addition 122 gal. per ton of ore is used for allaying dust on surface and pumping residue to dumps. At the outset the total consumption was 250 gal. per ton treated; this was before the installation of rock drills or cyanide plant.

For an ordinary stamp-plus-tube-mill-plus-cyanide mill, I estimate the total consumption of water *in the mill* at 90 gal. lost per ton milled.

A member of the Cyanide Club writes me of his troubles resulting from a wet-crushing flow sheet evolved as the result of experiments on a dry-crushed sample: "Laboratory tests on the *dried* run-of-mine ore indicate a comparatively good extraction with 'straight' cyanidation. . . . Similar tests on the *wet* run-of-mine ore indicate a refractory ore whose primary slime makes the C.C.D. system . . . installed here look like a nightmare. . . . Having in view the disastrous results of using dry ore and dry crushing as a basis for recommending wet crushing of a wet ore, I wonder whether such a case as this . . . has occurred before."

Handling Pulp—I was astounded at the heavy consumption of power used by air lifts. Convenient they may be, but 20 per cent of the total power used in a mill is too high a price for mere convenience. C. A. Lantz, writing from Mexico, speaks of the high efficiency of the Wilfley slime pump. His appreciation of this pump is shared by many well-known users, as may be seen by its increasing inclusion in the flow sheets of famous installations.

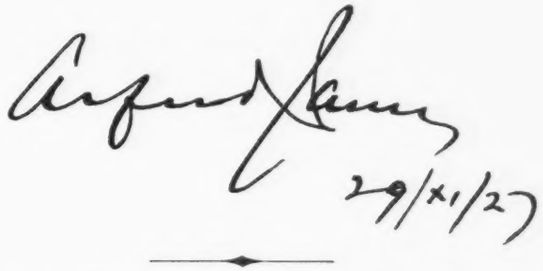
Cyanide Recovery—Lantz also tells me of his saving of cyanide by the Mills-Crowe recovery plant—95 per cent of the cyanide formerly going to waste in the river with the tailings. He estimates the actual saving at $8,000 (U. S. currency) monthly. At the Real del Monte, also, the cyanide is being recovered from the waste solutions, in a product of high strength available for transport.

The recovery of cyanide is not a matter of serious import; for gold mines using it, it may be from 4 to 6 oz. of cyanide per ton treated, but in silver mines, where the consumption is in pounds per ton, recovery and regeneration are deserving of closest attention.

Agitation—In the recent description of Chuquicamata (*Engineering and Mining Journal,* Sept. 17, 1927, p. 445) Mr. Burr Wheeler announces his adoption of one of our Mexican air-lift agitators (the Parral) at his mine. It is extraordinary how widely Brown's system of air-lift agitation has been adopted into the base-metal metallurgical industry.

Lox—Mr. Burr Wheeler somewhat surprised me by his announced intention of blasting over fifty thousand tons of ore a day by liquid oxygen. As a result of my reference to it in this letter for 1922, and of the paper I read (to the I.M.M.), I received letters from perhaps the majority of well-known mines over the world. In only one case did I find the data in favor of adoption really convincing, that of the Braden mine.

LIQUID OXYGEN as an explosive requires cheap power and a comparatively easy broken ore. Braden has that cheap power. Generally speaking, the use of liquid oxygen in mines is seriously limited by its specific gravity; in my paper I stated "In practice 2 by weight of liquid oxygen generated equals 1 of 40 per cent dynamite (gelignite)." As Cullen foresaw (see discussion on my paper), this greater bulk very seriously limited the use of this explosive in hard ground: compact rock requires more cartridges than can be pressed into a hole, and the stronger the power of the cartridge the bulkier it is (the lighter its specific gravity). Liquid oxygen would seem to have its real field in quarry work, where ore is less compact and more easily shattered, and in mines with non-explosive atmospheres where black powder is used.



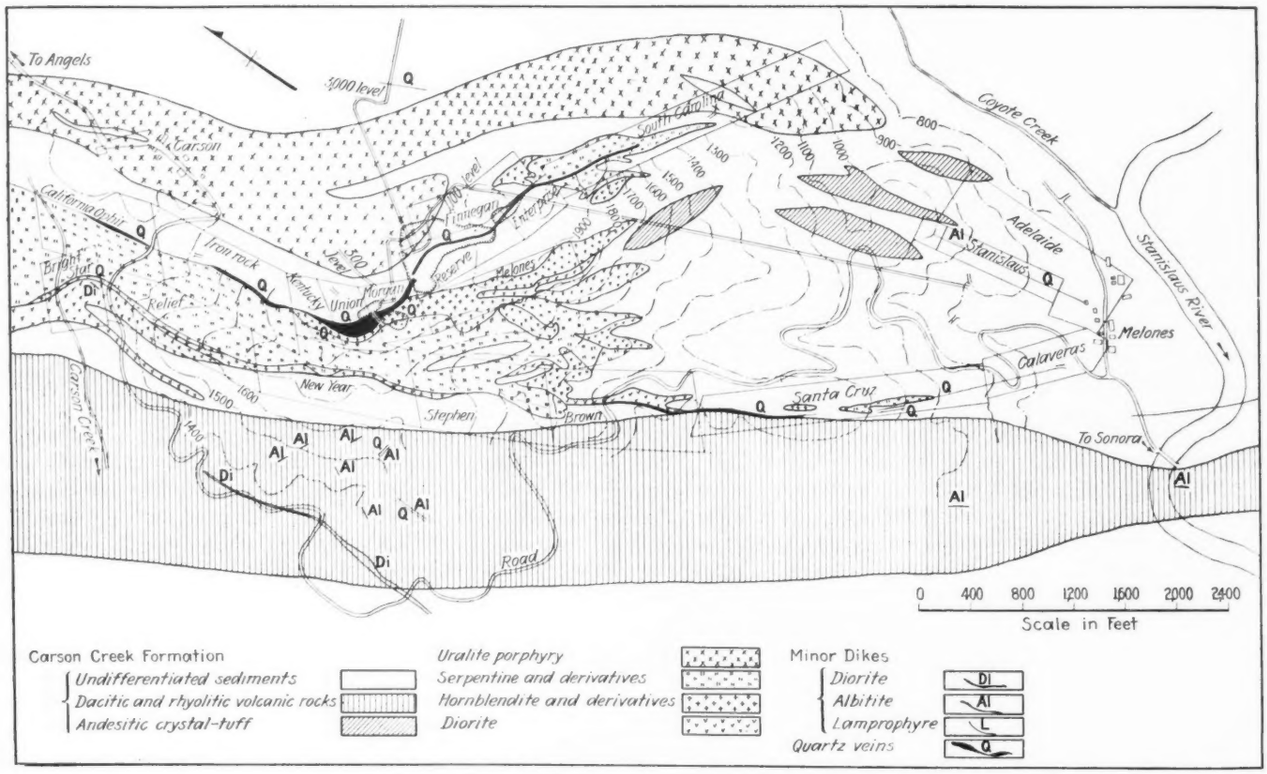
Radium Production in Czechoslovakia

The production and sale of radium is a government monopoly in Czechoslovakia. According to *Foreign Trade Notes* of the U. S. Department of Commerce, the government owns and operates mines and refineries at Joachimsthal, and the total production has heretofore been reserved for research, education, and clinical uses. Sales will be made to private individuals hereafter through the government-owned Mining and Metallurgical Company. The plant at Joachimsthal is being enlarged to permit increased production.

In 1925 production came to 1,377.9 milligrams of radium, and a future production of 6 grams per annum is planned. During 1926 the mines produced 103 metric tons of uranium ore.

The Geology of Carson Hill

By FRANK A. MOSS
Mining Geologist, Berkeley, California



Generalized geological map of Carson Hill, Calif.

GOLD WAS DISCOVERED on the summit of Carson Hill, California, early in 1850. In the two succeeding years about three million dollars' worth of extremely rich ore was mined from one claim, the Morgan. The richness of the claim led to a gold boom, and the town of Melones, then on the southwestern side of the hill, with a population of about 4,000, became the largest mining camp in the state. After the boom mining operations continued on various claims on a small scale. No authentic information concerning these operations is available, but it appears that the ore was obtained from rich and narrow veins near the surface, possibly secondarily enriched. At one time, 50 arrastres were working in the district.

It was not until 1898, when the Melones Mining Company began operations, that systematic mining and milling were introduced. This company worked continuously, with remarkably low costs, until 1919, when its ore reserves were thought to be exhausted. It was mining (a) the lower part of the Morgan orebody; (b) a body of ore in the footwall of the quartz vein; and (c) a large amount of low-grade ore from the glory hole on the Reserve claim. In 1918 the Morgan mine was reopened by the company operating the Calaveras mine, and the Carson Hill Gold Mining Company was formed to operate both properties. Since then, the upper part of the Morgan orebody has been extracted; the flat veins have been discovered; and a second body of ore has been developed below the 3,000 level of the Melones mine. The production of the company between 1918 and 1922 was about $5,000,000.

In 1894 the geology of the area was sketched in outline by H. W. Turner on the map accompanying the Jackson Folio of the Geologic Atlas of the U. S. Geological Survey. A map on a larger scale appears in the Mother Lode District Folio, by F. L. Ransome, the field work for which was done in 1898. No details of the local geology are given in these folios, and such terms as "Calaveras formation" and "amphibolite schist" are employed to cover a wide range of rock types.

The generalized geological map of Carson Hill that accompanies this article embodies some of the principal results obtained in a detailed field and petrographic study of this and the adjacent part of the Mother Lode. A full account will be published elsewhere.

In the area described the oldest rocks constitute a sedimentary and volcanic series at least 5,000 ft. thick. To this series I have given the local name of the "Carson Creek formation." The formation is best exposed west of Carson Hill (outside the map area), where it is overturned and dips at an angle of about 60 deg. toward the east. The strike of the rocks is N. 50 deg. W. and

is uniform for at least 10 miles to the northwest. Sediments in the lower part of the formation are chiefly conglomerates with a few thin partings of sandstone. Near the bottom of the section there is a series of hornblende-dacite lava flows and rhyolite tuffs, which ranges in thickness from 900 to 1,700 ft. The upper part of the formation is slate, mostly tuffaceous, and contains several lenses of limestone and beds of andesitic crystal-tuff. At the top is a thick and massive bed of andesitic tuff, in places containing much admixed sediment. The upper part of the formation is repeated east of the Calaveras-Relief vein zone. This vein zone—the local portion of the Mother Lode—is a thrust fault of large displacement along the axis of a fold. Unfortunately, the structure in the slate is not clear; but on the southeastern side of Carson Hill, two closely adpressed anticlines appear to be overturned toward the west and dip 65 deg. E.—that is, parallel to the cleavage.

The folded slates in the central part of the map area were intruded, parallel to the cleavage, by dike-like bodies of basic rocks. The first of these was a porphyritic rock containing phenocrysts of pyroxene and approximating an andesite in composition. Slight dynamic metamorphism destroyed the original minerals of the groundmass and changed pyroxene to amphibole. The metamorphism is nowhere sufficiently intense to warrant the usage of the term "amphibolite," as in the Survey folios; the rock should be classed, rather, as "uralite porphyry."

Intrusion of the uralite porphyry was succeeded by the injection of a group of closely associated dikes, consisting of: (a) serpentinized peridotite, locally recrystallized to antigorite serpentine; (b) hornblendite, in places feldspathic; and (c) albite diorite. All these intrusive rocks are cut by short, irregular albitite dikes, composed almost wholly of albite feldspar. Finally, a group of small hornblende lamprophyre (malachite) dikes was injected along post-cleavage joints. These last dikes are similar to those that commonly cut the granite and granodiorite of the Sierra Nevada.

Pressure, similar to that which produced the cleavage in the slate, appears to have continued after the period of intrusion of all but the lamprophyre dikes. The earlier intrusive rocks were sheared thereby, particularly along their margins. The common mesh-structure serpentine was recrystallized to antigorite serpentine.

Chemical Alterations

Far-reaching chemical changes affected the ultra-basic rocks. Prior to the formation of the ore deposits, the hornblendite was altered, locally, to rocks composed of chlorite (clinochlore) and rutile, with or without small amounts of muscovite, albite, and quartz. Part of the lime liberated by this change is contained in veins of zoisite. After the deposition of the older ores, to be discussed hereafter, the whole country was soaked in solutions containing, principally, carbon dioxide and a little lime and potash. These solutions altered the chlorite rock and serpentine to rocks composed of quartz and magnesium-iron carbonate (bruennerite). Talc-carbonate rock is an intermediate stage in the alteration of serpentine. In some places the green chromium mica, mariposite, was developed in certain quartz-carbonate rocks derived from serpentine. The latter rocks, either with or without mariposite, occur only in ore-bearing areas. This localization suggests strongly that the solutions which formed the quartz-carbonate rocks were related closely to those that deposited the ore minerals.

The most persistent quartz veins cropping out in the area are in the Calaveras-Relief and South Carolina-Iron Rock vein zones, which are zones of shear parallel to the cleavage and to some of the intrusive contacts. Other veins occur along the margins of albitite dikes or as isolated lenses in sheared rock. With the exception of a shattered part of the vein on the Calaveras claim, all the veins observed are barren of sulphides or gold. Their relations to the inclosing wall rocks are usually obscured by shearing, but it is evident that they are not connected with any wall-rock alteration. It seems that they are most probably the result or replacement.

Characteristics of Orebodies

The most productive orebodies in the area were found in the footwalls and hanging walls of the wide barren quartz vein on the Morgan and Reserve claims. They were mineralizations of the sheared rocks with pyrite and free gold. The more important, the Morgan, was a body of high-grade ore that extended from the surface to the 2,800 level. It was formed by the carbonation and metallization of a sheared chlorite rock lying on the hanging wall of the quartz vein, in the trough of a curve. The metallic minerals were abundant pyrite, and a little chalcopyrite, galena, and free gold also occurred. The gangue was a granular aggregate of a magnesium-iron carbonate, containing, in places, some lime. Relics of chlorite rock gave the ore a grayish-green tint. Probably the ore was localized in the Calaveras quartz vein, mentioned above, owing to the fact that the shattered quartz offered an easier passage to the metallizing solutions than did the highly sheared and tightly compressed wall rocks. Many of the albitite dikes in the area are carbonized and pyritized, and constitute low-grade orebodies, but none has been mined.

An entirely different type of ore deposit, the flat veins, is found in the Morgan-Melones mine in four thrust faults, which strike N. 55 to 65 deg. W. and dip 25 to 35 deg. E. They are definitely later than the quartz vein and the Morgan orebody, which they displace for distances of 10 to 125 ft. The flat veins consist of barren white quartz, mineralized by pyrite and clear, glassy quartz along the hanging wall or internally along fractures. Tetrahedrite and a little galena, pyrite, chalcopyrite, and pyrrhotite were found in places. Dolomite, either manganiferous or containing up to 5 per cent iron, is abundant locally in the ore, and may form large replacement bodies in the hanging walls. The typical wall rock alteration results in the formation, by the addition of potash, sulphur, and carbon dioxide and the removal of soda, of a cream-colored rock composed of muscovite, carbonate, quartz, and cubes of pyrite; such alteration is characteristic of the veins in the Grass Valley and Ophir districts. The quartz and ore seem to have replaced the fault gouge, and the positions of the oreshoots appear to be connected in the fault surfaces.

Enrichment of the Morgan orebody near the intersections of the oreshoot and the flat veins by flat-vein metallizing solutions is not noticeable in the production records. Streaks of mineralized quartz and micacized relics of sheared chlorite rock in the ore indicate, however, the upward passage of metallizing solutions. Shattering of the rock near one of these intersections permitted extensive mineralization.

Post-mineral disturbances in the two main shear zones are indicated by brecciated quartz; by deeply grooved striations along the vein on the Reserve and Morgan claims; and by the fractured and rounded crystals of

pyrite in the ore. The flat-vein thrust faults, also, were active after their mineralization, and in many places the ore is brecciated. The lower part of the Morgan orebody is cut by a few faults of small displacement, which appear to be connected with the flat-vein faults.

Origin of Ore

Concentration of metallic minerals into orebodies demands not only favorable conditions of temperature and pressure, but also that the metallizing solutions should have access to suitable host rocks. In the Morgan orebody, the sheared rock between the quartz vein and the uralite porphyry in the curve of the vein afforded an adequate channel for infiltration, the more so because it could be opened by a slight displacement along the shear zone. Moreover, the small strip of sheared chlorite rock was a host rock especially susceptible to metallization. The flat-vein oreshoots appear to be in areas of relative permeability created by movements on slightly curved fault surfaces.

The sequence of events in the formation of all the ores at Carson Hill was the same. First, a fault zone was filled with barren quartz; then, after the fissure was reopened by faulting, the metallic minerals were introduced. The Morgan orebody was formed by carbonated solutions; after carbonating the chlorite rock, they deposited, in the following order: pyrite, chalcopyrite, galena, and free gold. The flat-vein solutions were largely siliceous; they deposited pyrite, chalcopyrite, tetrahedrite, galena, free gold, and quartz.

Both the age and genesis of the gold ores of the Mother Lode have been discussed by W. Lindgren and F. L. Ransome. Neither of them has described more than one period of metallization. According to Ransome, the fissures were formed after the granitic and dioritic intrusions, and the ores were deposited from ascending meteoric solutions. Lindgren states that the source of the gold is in the minor intrusions on the flanks of the Sierra Nevada, but admits that in many places the evidence points to the basic intrusive rocks and to the accompanying albite-aplite dikes as a source of at least part of the gold.

At Carson Hill the deposits are clearly of two ages and two types. The association of the earlier ores with a series of intrusive rocks ranging from basic to sodic acid in composition suggests that they are all products of the differentiation of a common magma. A similar association is found in many other auriferous areas. Probably, the later flat-vein ores were derived from a granitic magma, the proximity of which is suggested by many lamprophyre dikes. At Grass Valley and Ophir, gold-bearing quartz veins occur in the same fissures as lamprophyre dikes that are definitely associated with granite (granodiorite). There, also, the wall rock alteration of the diabase and "amphibolite" appears to be identical with that observed at Carson Hill.

Carmen Pit at Cerro de Pasco, Peru

Copyright by Ewing Galloway, N. Y.

Silver ore was mined here more than 300 years ago

Mining With Filled Stopes

PART II—SUPPORTED METHODS

By CHARLES A. MITKE
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THE Mitchell stoping method, as it is known in some camps, is really a combination of square-set stoping and underhand pillar work. Fig. 1 shows a skeleton of a Mitchell stope. Pillars of ore in place are shown in the center, and a series of square-set stopes on both sides of the pillars have been taken up from one level to the capping. After the square sets were taken up, and the majority of them had been filled with waste (except those to be used as chutes), underhand work with jackhammers was started on both pillars, to take them down from the capping to the next level. The drawing shows one pillar of ore to have been taken down three sets and the other four. In this instance, stringers 16 ft. 6 in. are being put in as the work progresses downward. This type of stope is used in medium, but is not applicable to heavy, ground. The amount of timbering is less than is required in the ordinary square set, but if the stope is heavy the same quantity must be

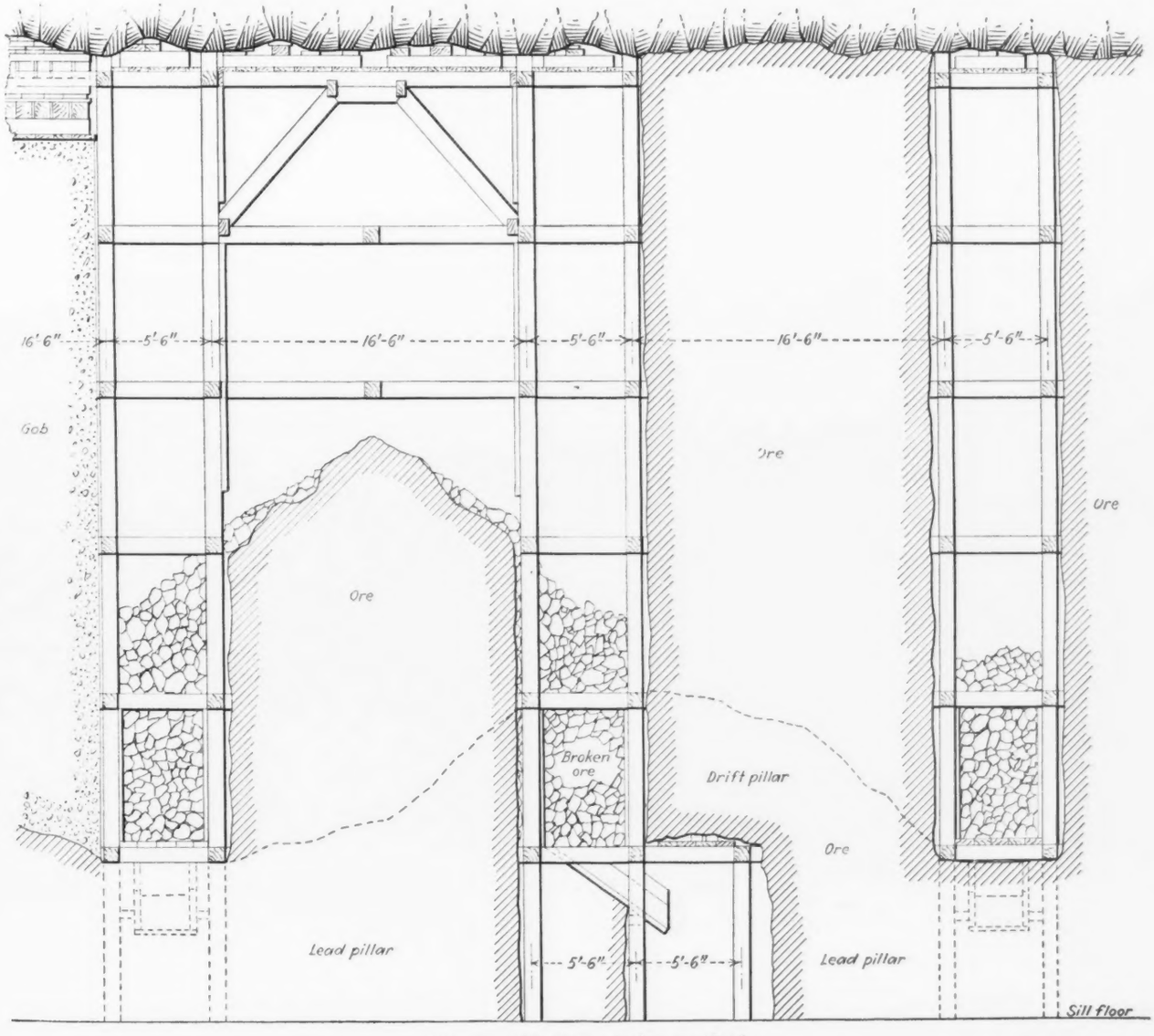

Fig. 1—Mitchell stoping method

used. However, the advantage which really justifies its use at times is that the pillar ore can be mined more cheaply and more rapidly than if the entire block were stoped by straight square setting throughout.

This method has its application where the weight is not too great and where the back of the pillar stope will stand unsupported, while the entire ore is being taken out from the level above to the level beneath, a distance of 100 ft. Very few orebodies lend themselves to this class of stoping, and probably not more than twelve or fifteen Mitchell stopes are being worked at the present time. In the Magma mine, at Superior, Ariz., this method has had almost an ideal application, although the tendency now is toward square setting, owing to heavier

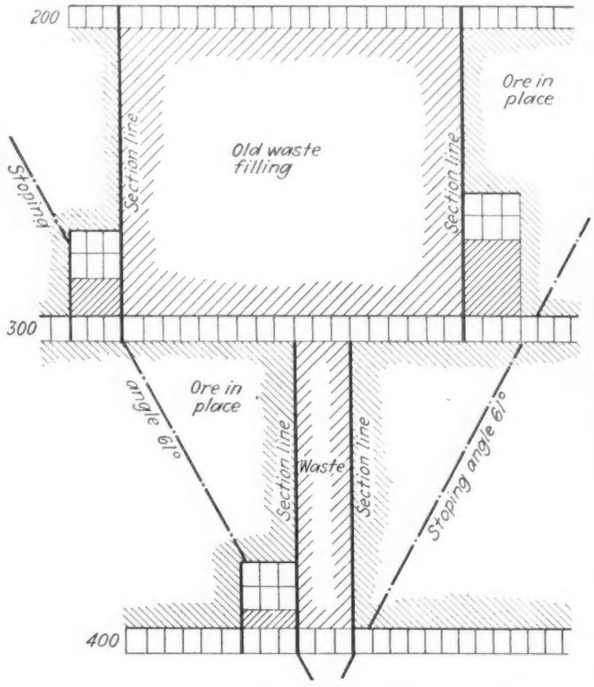

Fig. 2—Square-set stoping: Correct method

ground being encountered with depth. A few such stopes are to be observed at the Junction mine of the Calumet & Arizona Mining Company, at Bisbee, Ariz.

There is a certain flexibility to this system. When the ore in the pillar has been taken down, say, 50 to 60 ft., if the back becomes heavy, flooring is laid over the stringers directly above the workmen, and the open space above is filled with waste. This steadies the ground so that the remainder of the ore beneath may be extracted in safety.

In laying out a block of ground for square setting, the stopes should be laid out on the highest level first. Then, after a certain section has been completed and filled, a second section should be started beneath, as shown in Fig. 2. When two stopes, having a total width of six sets, have been carried up to the level above, and filled, then a third section may be started beneath, and so on. Experience has shown that it is not good policy to carry producing sections vertically beneath others, as the extraction in the lower section invariably makes the upper sections heavy. This is illustrated in Fig. 3. Here, six sections of square setting are being carried on three different levels. The four lower sections are directly beneath the two sections on the 500 level. The tendency in such circumstances is for the ore above the stopes on the two upper levels to get heavy and add to the difficulty of stoping, which will naturally increase the cost.

As a principle in square-set stoping, the various levels should be kept in step; that is, a certain volume of ore should first be removed in the upper level, a lesser amount on the level below, and so on. (See Fig. 2.) The angle of approximately 61 deg., which has been adopted as the stoping angle in Fig. 2, has been found in practice to be a very much safer angle than that of approximately 90 deg., as shown in Fig. 3. There is an economic limit, however, as to how far the upper levels should be kept ahead of the lower ones. For example, if on the 300 level, in Fig. 2, very much more ore should be stoped out (and much more fill put in), an undue repair cost would be encountered in maintaining passageways on this level in order to fill stopes that will later be carried up between the 300 and 400 levels.

Cut-and-Fill Method

The cut-and-fill method is exactly what the name implies. First, a cut of about 5 ft. of ground is made, either on the horizontal or the incline. After this is extracted, a fill is made by putting waste in the stope to take the place of the ore.

About 80 per cent of the ore mined at the Copper Range Consolidated Copper Company, at Painesdale, Mich., is produced by the cut-and-fill method, which is also responsible for the extraction of 60 per cent of the ore of the Calumet & Arizona Mining Company, Bisbee, Ariz.; 65 per cent of the production of the United Verde Copper Company, Jerome, Ariz.; 65 per cent of the ore of the Pilares mine of the Phelps Dodge, Nacozari, Sonora, Mexico; 70 per cent of the ores of the Santa Gertrudis and the Real del Monte, Pachuca, Mexico, and more than 50 per cent of the underground ore of the Tharsis mine, Rio Tinto, Spain. The method is also used in the tin and silver mines in Bolivia, South America.

The cut-and-fill system is used in orebodies which are firm and which stand temporarily with little or no timber.

There are two general methods of carrying stopes by the cut-and-fill system—the horizontal and the incline.

The horizontal system is the method most generally used at Painesdale, Mich.; by the United Verde Copper Company, at Jerome, Ariz., and in operations at Nacozari and Pachuca, Mexico. This method is illustrated in principle in Fig. 4. After the orebody is thoroughly blocked out, so that its limits are known, raises are located in suitable places, so that there can be a rapid flow of ore out of the stope, while waste is being turned in above to take the place of the broken ore.

A cut of ore, 5 ft. to 10 ft. thick, is taken from the back the entire width of the stope. The length depends on the length of the orebody. The back is usually never more than 10 ft. above the working floor. When the cut has been broken down the width of the stope and the ore has been recovered, filling is put in and the same operation is repeated above, until the entire height of the ore has been extracted. One of the advantages claimed for this method is that if large boulders of waste occur with the ore, necessitating sorting, these may be left in the stope and thrown back into the fill.

Where mining is done on a horizontal plane, such sorting can readily be accomplished. Furthermore, in foreign countries, where native labor is employed, as in Mexico, the natives have been trained to this class of mining for many years and have become quite expert in mining the ore and sorting out boulders. Such work

is frequently contracted, and very low stoping costs are obtained. This is one of the few stoping methods in the practice of which contracting has been generally applied.

As will be noted from the drawing, nearly all the ore is shoveled by hand, and wheelbarrows and small cars are generally used. The same is true in spreading the waste in the stope. The waste is drawn from the chutes into cars or wheelbarrows, and then spread through the parts where it is most needed.

Incline Cut and Fill (Untimbered Rill)

The incline cut-and-fill method is most generally used at the Calumet & Arizona Mining Company property at Bisbee, Ariz., and to a lesser extent in a number of the other camps, such as Globe, Butte, and in a few mining districts in foreign countries. Fig. 5 shows the general procedure in carrying an incline cut-and-fill stope, either on a small or a large scale. Where the veins are large, these stopes are repeated. All the ore runs by gravity. The waste fill, which is turned in from above, is distributed in the same manner. This type of stope is frequently used in narrow to moderately wide veins, where the ore and walls are fairly strong, but where shrinkage could not be applied without undue caving. Vertical, or nearly vertical, veins are most favorable for the adoption of this method. The method is also being satisfactorily applied to massive deposits.

The "umbrella stull" shown in the drawing is seen occasionally, and square-set timbering is used for ore chute, manway, and waste compartments. Owing to the elimination of handwork, it may readily be seen that a few men can produce a large tonnage in a shift. This method, of course, has its ideal application in orebodies where very little sorting need be done, or where the blocks of waste are large enough to leave in the back until the stope is ready for fill, when they can be blasted down into the waste during the process of filling. Under such conditions, a very low mining cost is obtainable.

Shrinkage with Subsequent Filling

Shrinkage with subsequent filling is the same type of shrinkage formerly described under open stopes, with the difference that, in general, the stopes are wider, and, after the broken ore has been drawn out into cars in the drifts beneath, waste fill is turned in from above. The ground must be sufficiently strong to hold up the back until all the ore is drawn out and the waste fill put in. In small orebodies, the entire ore is taken out and the stope filled completely. In larger orebodies, pillars of ore are left intact while the stopes are being mined. After the waste has been turned into the open stopes, the pillar ore is extracted by some other method.

The pillars are mined by a variety of methods. Sometimes square setting is used; at times top slicing; and, in some operations, cut and fill. In all instances the shrinkage stopes are first completed, all the ore is drawn out, and the stopes are filled with waste; then the mining of the pillars is begun.

The Homestake mine, in South Dakota, uses shrinkage with square setting in the pillars. At Franklin Furnace, N. J., shrinkage and top slicing of pillars is practiced. This is also the custom in some of the iron mines in Minnesota.

On rare occasions, in medium- or high-grade ores where the walls are not very firm, square-set timbering is carried up occasionally, without the use of floors, in order to steady the ground until such time as the entire stope is filled with broken ore, and all of it may be drawn, after which filling is added. This is really a combination of shrinkage stoping with square-set timbering and filling.

In general, with all the fill methods, it has been found more advantageous to leave the sill floor in place and start stoping above drift sets, than to remove the sill and shovel the ore by hand. When the sill floor is left in, it

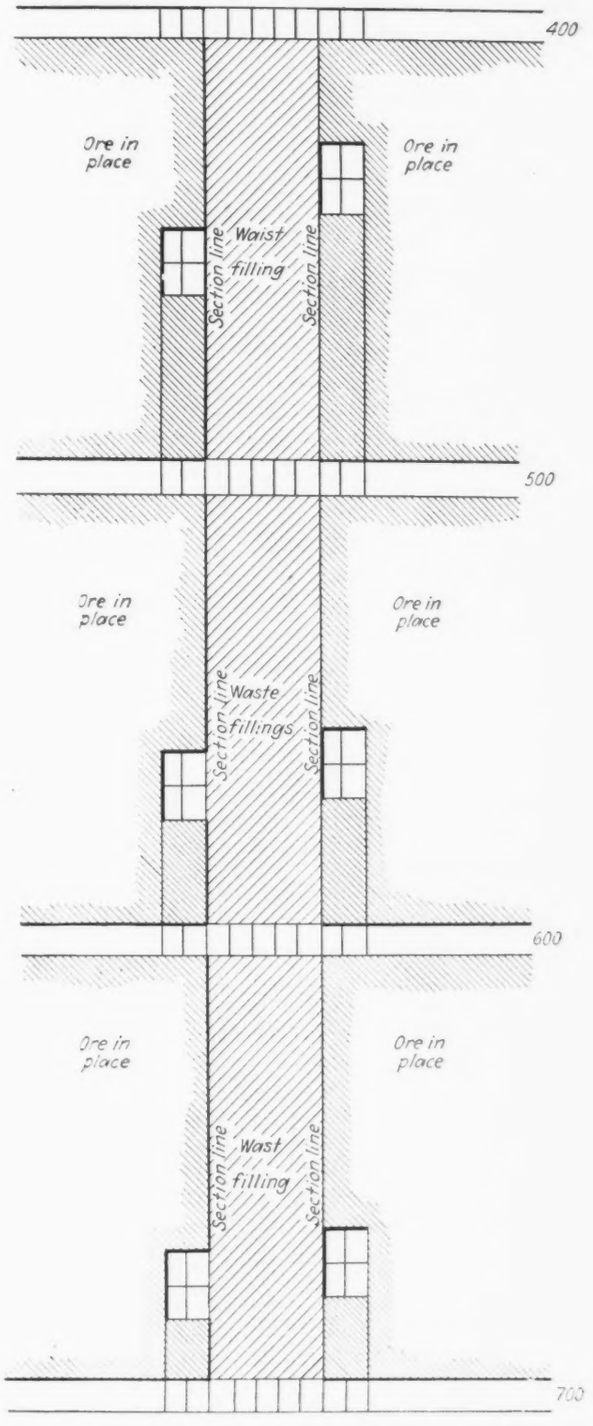

Fig. 3—Square-set stoping: Incorrect method

is usually recovered from the level below, and it protects the working drift while the ore above is being extracted. Furthermore, it also eliminates hand shoveling. The argument advanced in favor of taking out the sill floor before starting stoping is that the orebody may be

prospected at the start. However, that can be done just as well on the second floor as on the sill floor.

Though in a number of instances the sill floor is taken out when a stope is started, nevertheless, in the majority

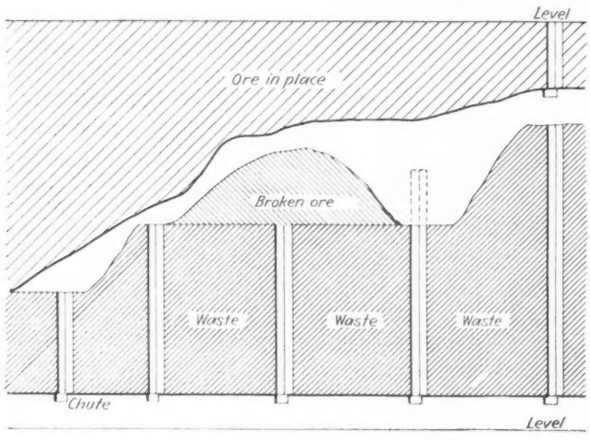

Fig. 4—Horizontal cut and fill

of such operations, it pays to recover the sill ore from the level below.

Fill methods are indicated as applicable—

Where underground caving or surface subsidence is not permitted.

In higher grade ores, requiring complete extraction.

Square setting is especially adapted to irregular orebodies for following ramifications of the ore.

Prospecting may be carried on within stopes, and sorting and selective mining are possible in both square-set and cut-and-fill methods.

Square Set

The horizontal square set with narrow sections (approximately two sets wide and five to ten sets long) is used in *very heavy ground.* Close filling is practiced, and 12x12-in. timbers are used. The ore is shoveled by hand, either directly into chutes or into wheelbarrows, and then trammed to the chutes.

In ground not quite as heavy as that mentioned above, where close filling is not necessary, 3x4 set sections to 5x6 set sections may be taken, depending upon the strength of the ground. Here, there is a choice between the horizontal square set and the square set with slides, sometimes called "timbered rill." Where the square set with slides can be used, hand labor is largely eliminated, and the cost reduced, as the miner blasts the ore down upon the slides, whence it runs directly into the chute. By locating the waste raise in the proper place, a greater advantage is gained, as the waste may frequently be turned into the stope below the slides, while ore is being produced above them.

There is a question as to whether cheaper costs can be obtained with the "combined overhand square setting and underhand pillar work" (Mitchell stoping method) than with the "square set and slides." Both are applicable to about the same character of ground. If anything, the square set with slides might be used in a little heavier ground than the combined method. There is a slight saving of timber in the Mitchell stope, in that stringers only, instead of full square sets, are used as the pillar is being extracted. However, in extracting the ore on either side of the pillar, the leads of square sets are carried into the solid, which usually costs a little more in breaking than in operations where a section three or four sets in width is taken and slides are used.

Square-set methods previously described cover all square-set methods now in general use. There are, however, many details in the manner in which such stopes are started, and in the method of timbering and in carrying out the work. It must be borne in mind, however, that these are merely details—important, perhaps, but still details—and not methods or variations of methods.

For instance, in the exceptional instances where a square-set stope is carried downward, or underhand, some use the long 15-ft. stringer; others start off with a 10-ft. stringer; still others use regular square sets. The choice is governed by the looseness of the ground, or some other local characteristic, but the ultimate result in each case is an "underhand square set."

Likewise, when square sets are carried upward, in those instances where it is desired to eliminate hand work as much as possible, sometimes a great many chutes are put in, so that there is a chute in every drift set beneath a stope; whereas others may only use one or two chutes. Also, some sections are taken up vertically, and others are stepped. In some stopes, the slides are put in at an early stage, and stoping and filling carried on simultaneously, the ore running on top of the slides, while the waste is turned in beneath. At other properties, several sets are first mined out; then production is stopped until the stope is completely filled with waste—the filling lying at an angle—when boards or slides are laid on top of the waste, and the ore above is blasted down. In such operations, the timbering is called a "flooring" instead of a "slide." When square-set timbering is used in a rill stope, the result is practically the same as a square set with slides, or a square set with incline flooring on top of the waste. The timbered rill is practically the same as the square set with slides, carried step fashion. Occa-

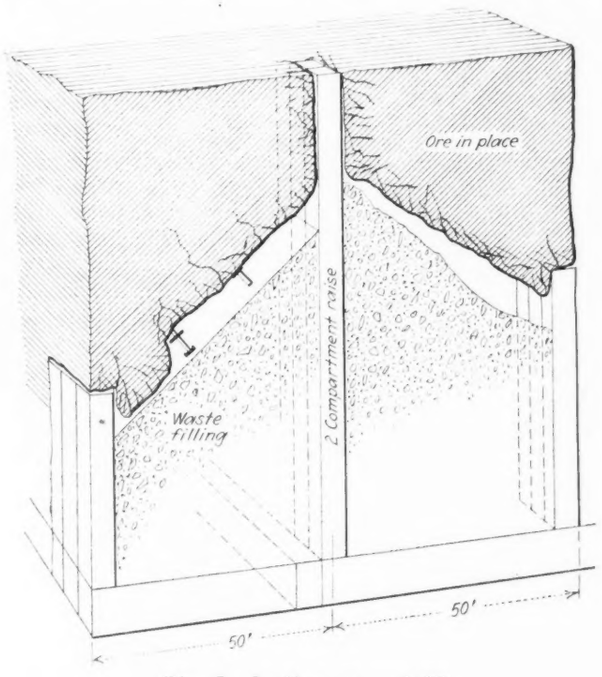

Fig. 5—Incline cut and fill

sionally, in the timbered rill, if the veins are narrow, no lagging is used on the sides, and the stope more nearly resembles an incline cut and fill. However, if large ore masses are stoped by this method, several sections are

started at the same time, but the work on one is pushed rapidly ahead, so that it may be completed and filled by the time the next section is halfway up. In this way the filled section, the sides of which must be carefully lagged, acts as a pillar.

Occasionally horizontal square sets, where no slides or flooring are used, are known as "flat-back square sets." The term "overhand stoping with square set timbering and waste fill" applies equally to all square sets carried upward.

Cut and Fill

The cut-and-fill methods are applicable to ground where both the ore and walls will stand temporarily without timber. The horizontal cut and fill is used where waste occurs with the ore and much sorting must be done; whereas the incline cut and fill is most successful when little or no sorting is required.

Because the horizontal cut-and-fill method involves the use of hand shoveling and hand tramming in transferring practically all the ore in stopes to the chutes, and also in handling and spreading of fill in stopes, whereas, the incline cut-and-fill method utilizes the principles of gravity in handling both ore and waste, it is apparent, as proved in practice, that the *incline cut and fill* is the *lower-cost method.*

There are a number of variations in the application of both the cut-and-fill methods, consisting principally in the length and width of stope, height of cut or slice of ore taken, and manner of cribbing or timbering. The horizontal cut and fill is variously known as overhand stoping and filling; longitudinal flat-back stoping with contemporaneous filling; and many other terms. The incline cut and fill is practically the same as the untimbered rill.

Shrinkage with subsequent fill is used where the ore is firm enough to stand (so that men can drill beneath it) and the walls are strong enough to stand until all the ore is mined out of the stope. When this stage is reached, waste is turned in and the stope completely filled. In such an orebody, cut and fill might also be used, but at a higher cost than the shrinkage with subsequent filling. No sorting, of course, is permitted with the shrinkage and subsequent filling.

There is considerably less fire risk with the cut-and-fill and shrinkage-and-fill than with the square-set method, as by far the greater amount of timber is used in this last-named method.

Magnesium Industry of Growing Importance

By John A. Gann and Arthur W. Winston

Abstracted from *Industrial and Engineering Chemistry* for October

MAGNESIUM is rapidly winning recognition as a useful engineering material. Practically unknown before the war, except in the college laboratory, it is now assuming real commercial importance. Because it is the lightest metal known to science possessing properties of permanence and stability, magnesium has long been a material of interesting possibilities to engineers, but any commercial application on a large scale was forced to wait upon lower manufacturing costs and the development of high-strength alloys. Both of these preliminary steps have now been so far accomplished that the cost of magnesium today compares favorably with that of the older metals, and alloys are available possessing strength and other properties amply sufficient for their intended uses. Eventually, magnesium will find extended applications in industries generally, as well as those particularly concerned with automobile and aircraft manufacture.

Magnesium may be commercially produced by electrolysis of a fused chloride or of a fused fluoride-oxide bath. All European magnesium and the greater portion of that now being produced in this country is made by the chloride process. The development of a low-cost raw material together with modifications of European practice has made the chloride process an economic success. Dehydrated magnesium chloride is now commercially available. This has substituted continuous operation of electrolytic cells for the batch process required when using mixtures of magnesium chloride with sodium chloride or potassium chloride. Still further advance was made when it became possible to use a partly dehydrated magnesium chloride. The metal thus produced is very pure, as shown by the analysis in Table I.

Table I—Analysis of Commercial Magnesium

	Per Cent
Copper	0.015 ± 0.005
Manganese	0.005 ± 0.002
Silicon	0.020 ± 0.005
Chlorine	0.015 ± 0.005
Iron and aluminum	0.025 ± 0.005
Magnesium	99.92 ± 0.02

Table II—Yearly Magnesium Production

Year	Pounds	Value	Average Ingot Price per Pound
1921	48,000	$86,000	$1.30
1922	60,000	89,000	1.60
1923	125,000	155,000	1.25
1924	128,000	150,000	1.07
1925	245,000	274,000	0.86
1926	322,650	390,400	0.80

The increasing use of magnesium is indicated in the domestic production statistics of the U. S. Department of Commerce, which include castings and other fabricated forms as well as ingot metal. As production increases, there is no inherent reason why magnesium cannot compete with aluminum on a weight-for-weight basis.

Table III—Magnesium Production—1926

Class	Pounds
Castings	36,940
Tubing, wire, and powder	50,710
Ingots	235,000
Total	322,650

The greatest development in the uses for magnesium will be in the extension of the engineering and structural application of its ultra-light alloys. A saving of three-quarters of the weight is possible where they replace steel and one-third where they are substituted for the light aluminum alloys. The strength properties are good, even on a volume basis, and are quite superior on a weight basis.

An interesting though restricted use of magnesium is for the press-forged resonator disks for automobile horns. No other metal produces such clear and resonant tones as do certain magnesium alloys. Many hundreds of thousands of these horns have been made, and they are standard equipment in several of the better grades of motor cars. There are possibilities in utilizing this property in other sound-producing or amplifying apparatus.

DISCUSSION

Emergency Synthesis of Potassium Xanthate

THE EDITOR:

Sir—Potassium xanthate is a well-known "promoter" in flotation processes, and by sheer merit of operation a favorite for most ore concentrations. Occasionally a supply of it, needed in a hurry, may be unobtainable unless resource is had to its preparation from easily procurable materials.

A situation such as this faced me recently and caused me to investigate how to make potassium xanthate. So easy is the preparation, and the yield relatively so high, that I have the temerity to pass on the experience to those unfamiliar with it, who might be interested.

Potassium xanthate is a chemical compound made up of the elements potassium, sulphur, carbon, oxygen, and hydrogen; graphically represented it takes the form: $S:3\begin{matrix}OC_2H_5\\ \diagup\\ \diagdown\\ SK\end{matrix}$. This compound is obtained by the action of ethyl alcohol and potassium hydroxide (caustic potash) on carbon bisulphide. The chemical reaction that takes place in its synthesis is expressed as follows:

$$C_2H_5OH + KOH + CS_2 \rightarrow S:C\begin{matrix}OC_2H_5\\ \diagup\\ \diagdown\\ SK\end{matrix} + H_2O.$$

Organically, such a reaction is often called an external condensation. The first part of the preparation consists in heating 56 parts of potassium hydroxide together with 46 parts by weight of ethyl alcohol (industrial spirit). The potassium hydroxide is placed in a glass flask and the alcohol poured over it. The flask is placed on a steam or hot-water bath, and the contents boiled until all the potassium hydroxide has dissolved in the alcohol, when a transparent white solid will be formed that slowly turns brown on exposure to air. The flask is removed from the heater and the contents broken up into small pieces. Next is added not less than 76 parts by weight of carbon bisulphide. The latter is so volatile, even at ordinary room temperatures, that it is best to fit the flask with a cork through which is fixed a vertical condenser (reflux), in which cold water from a spigot circulates, thereby returning the carbon bisulphide vapor to the flask. The flask is again placed on the hot-water bath and the contents heated until they assume a brownish-yellow color throughout. The reaction takes about two hours for completion.

The crude potassium xanthate thus formed is filtered and washed with alcohol, in which it is not so soluble as in water. The washing is continued until the filtrate is almost colorless. The liquor entangled in the crystals is removed by pressing the crystals with a flat glass bottle stopper. The crystals are next transferred to a sheet of folded blotting paper and pressed out. The remaining liquid evaporates after standing and leaves pinkish-yellow needles, readily soluble in water. If further purification of the compound is desired, the potassium xanthate may be redissolved in alcohol by gently heating, and allowed to stand. After some of the alcohol has evaporated, beautiful colorless needles of pure potassium xanthate will crystallize out, and can be obtained dry by the procedure outlined above. A solution of these in water will give, with a solution of cupric sulphate, a yellow precipitate, characteristic of cupric xanthate.

No special precautions are necessary during the preparation beyond keeping naked lights away, on account of the easy inflammability of the carbon bisulphide.

A 10 per cent solution of the potassium xanthate in water prepared as described gave satisfactory results in several ore concentrations made in an experimental Ruth flotation cell.

ERIC SINKINSON.

Lehigh University, Bethlehem, Pa.

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Selling Mines

THE EDITOR:

Sir—My experience in buying and selling mines convinces me that the demand for good mines exceeds the supply. When we have a mine for sale we should use the same business methods as in marketing any other commodity. The large mining corporations do not hesitate to announce that they are in the market for good mining property, and they investigate a great many each year. To show how expensive this proves to the large corporations, permit me to cite the fact that a few years ago 639 properties were submitted to an organization interested in mining. Three engineers turned down 538 on the data, 82 of the remaining would not stand up under the preliminary examination, and of the remaining 19 properties the company purchased only two. Such a series of investigations cost the corporation thousands of dollars—possibly as much as the two properties that were purchased. Most of the large corporations keep scouts in the field on the lookout for good mines.

Several kinds of purchasers are in the market for mines. The exploitation and development companies are organizations to explore and develop mining properties and then sell or operate the most promising property. Such companies have offices in many localities, and it is not difficult to induce them to send an engineer to examine partly developed mines. The larger mining corporations are generally in the market at all times for properties of the same kind as they are operating, as well as for properties containing fluxes in which their properties are deficient. Brokers offer many opportunities to sell on a commission basis—no sale no pay. The legitimate promoter affords another good opening.

Individuals in the market for mines are usually engineers commissioned by their clients, who are generally capitalists. Most engineers of prominence have from one to a dozen requests for mines on file at all times. As I view the selling situation, the first and best branch of the market for selling a mine is some well-known con-

sulting mining engineer. A great deal depends on the presentation of the mine in the engineer's report. Maps should accompany the report and definite statements should cover the body of ore, assays, and tons developed. The economic and business features should be fully covered, so as to give the investor's engineer an idea of the merits of the property. If he is not favorably impressed he will not advise his client to spend several thousand dollars in investigating the property.

The engineer wants to know whether or not there is a reasonable chance of making a mine and whether the operation will return the money invested and will pay a reasonable profit. Many good mines fail to attract attention on the market because of the unbusinesslike way in which the facts covering the property are presented. In presenting a mine the first important step is to select a competent engineer to examine the property and to prepare a report intelligently describing its merits.

Geer, Va. MARSHALL HANEY.

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Secrecy in Geophysical Exploration

THE EDITOR:

Sir—We note your editorial "Secrecy in Geophysical Exploration" in the Nov. 12 edition of *E. & M. J.* The Swedish American Prospecting Corporation, of which we are consulting engineers, is among the pioneers in the introduction of electrical methods of surveying on this continent. We are interested, naturally, in pursuing a course that will result in the greatest development of the science of geophysical exploration, particularly in the electrical branch. Following this course, the corporation and its parent company, Aktiebolaget Elektrisk Malmletning of Sweden, have expended and still expend considerable sums of money in research to improve methods and discover new procedures.

We infer from your editorial that geophysical exploration companies impede progress when they do not require, in contracts with clients, that they be permitted to make full publicity of results secured by the electrical surveys. We are of the opinion that if every company engaged in this work lays down such a requirement, there will be very few, if any, important companies that will have electrical surveying work done. We find practically all our clients require control over publicity of results.

We look upon relationship with our clients as a professional engagement and, while you refer to only a single contingency to justify a company in desiring secrecy, we can think of as many situations which make it desirable for a mining company to have electrical survey results kept secret as we can think of conditions which make it desirable for a company to keep confidential the results of findings contained in mining engineers' reports generally.

It would be our choice to make all results public, since that naturally inures to the public benefit as well as to our benefit, but we look upon the proposal as set out in your editorial as idealistic, because, after all, mining is no different in its commercial aspect from any other industry. It happens frequently that immediate publication of the results of an investigation would result detrimentally to the party who defrayed the cost of it. We do not believe you would hold for publication in such a case.

We believe that possibly *E. & M. J.* does not fully appreciate the very large amount of foreign and American literature now available having to do with the progress of this science, even though, as you rightfully state, its application from a commercial standpoint is comparatively new. We know of no important phase of the development of the science in connection with ore finding which has not been made public and this policy will be continued in so far as we are concerned. We believe that other responsible parties engaged in the application of geophysical methods can be no less desirous than we to exchange technical developments when the opportunity presents itself.

With regard to the matter of straightforwardness referred to in your editorial, it is certainly an admirable trait to shout aloud that you cannot do a thing, if you really cannot do it. But that does not mean that the thing cannot be done by others who know how. Skillful and experienced operators of electrical prospecting who are at the same time *geologists* are interpreting electrical indications all the time, as of metallic and non-metallic conductors, and the Swedish American Prospecting Corporation has in its records proofs of the accuracy of such classifications its engineers have made. Permission has already been obtained to publish some of these at the forthcoming meeting of the A.I.M.E.

These interpretations are made by taking into consideration both electrical and geological evidence and the geological evidence is frequently of as much importance as the electrical. It is possibly because of this that Dr. Mason makes the statement that ore cannot be distinguished from a barren conductor. Taken literally, this statement is correct, because no certain way has been found as yet to determine whether, when sulphides are indicated, they are of a grade sufficiently high to constitute ore or not, although different sulphides show highly varying electrical characteristics, a fact which points to possibilities along this line. ("Electrical Prospecting in Sweden," by Karl Sundberg, Hans Lundberg and J. Elklund, Bulletin 327, Swedish Geological Survey, p. 27.) But the statement, broadly interpreted and as between metallic and non-metallic conductors, is not correct, because much knowledge of the character of the conductors can be gained from its conductivity in one direction as compared with that at right angles, and its width and form in relation to the geological structure. Certainly, the detection of these features determines characteristics of a mineralized area. Determination of the width of the conductor seems to be a mysterious, not to say supernatural, procedure to some of the electrical prospecting operators, but our engineers have already published a number of examples of accurately outlining the limits, transverse as well as longitudinal, of an orebody. The latest example which has received publicity is the Buchans mine in Newfoundland, regarding which Mr. H. A. Guess is quoted in the issue of *E. & M. J.* which contains your editorial. We anticipate recounting the conduct of this survey at the February meeting of A.I.M.E.

The trouble with some of the new comers in the electrical prospecting field is lack of experience, with utter disregard of geological evidence. We regard knowledge of geology as important, in the practice of electrical prospecting, as knowledge of the abstruse fundamentals and mathematics of electrical science. There are people practicing electrical prospecting to whom the question of phase angle is unimportant because they never heard of it. There are also people who know all about the phase angle who are not sufficiently informed about geology to appreciate that an indication may result from the con-

tact of two formations. The profession of electrical prospecting has reached the stature of a specialty requiring intimate familiarity with the constant developments in the field of electrical science (with knowledge of the higher mathematics to permit of understanding them) and a thorough knowledge of geology—especially the geology of ore deposits. In this latter science, there is growing up a mass of information regarding the conductivity characteristics of different geological formations which will be of great value, particularly in oil prospecting, to which valuable contributions have been made by the scientists of Carnegie Institution.

To be of value to the property owner, electrical prospecting should "turn down" indications which do not emanate from metallic minerals. It is no help to a claim owner to receive a map showing his claim covered with a network of so-called indications. He might as well trench his claim at 50-ft. intervals at the start, as try to explore such a maze. In a mineralized region there are many conditions, other than a possible orebody, which give electrical indications, and inability to discriminate amongst them renders the work practically valueless.

It seems to us that, in endorsing the statement that "no electrical prospecting method will determine the character or value of a mineralized area," you retard the development of the art rather than advance it.

New York City. ROGERS, MAYER & BALL.

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War Memorial to American Engineers

THE EDITOR:

Sir—The Committee of engineering societies on War Memorial to American Engineers has just announced that the clock and the carillon for the tower of the new Louvain Library will be made a memorial to *all* engineers of the United States of America who gave their lives in service of their country or its allies at home or overseas or on the seas, in any branch of service in the Great War from 1914 to 1918. The Committee seeks information of all such men so that their names may be suitably recorded in this honor roll.

The Committee further announces that on the advice of its carillon architect, Frederick C. Mayer, who is also organist of the West Point Military Academy, the compass of the Louvain carillon has been increased from three to four octaves. It will thus have forty-eight bells and be at least the equal of the famous old carillon at Malines, Belgium.

To assure the excellence of the musical quality of the Louvain bells and the mechanical perfection of the playing mechanisms, the Committee has awarded the contract for the clock and the carillon to Gillett & Johnston, of Croydon, England. This firm made the carillon for the Victory Tower of the Parliament Houses in Ottawa, at present the finest carillon in the Western Hemisphere, and the carillon in the Tower of the Graduate School of Princeton University. It is also producing the great carillon for the new Baptist church on Riverside Drive at 122 St., New York City, being given by John D. Rockefeller, Jr., as a memorial to his mother. This carillon is to have more than a hundred bells and its largest bell, recently cast at Croydon, weighs twenty tons.

The Library building, the clock and the carillon will be ready for dedication July 4, 1928, it is stated by the architect, Mr. Whitney Warren, of New York City.

A. D. FLINN,

New York City. Director, Engineering Foundation.

By the Way

New Variety of Andesite?

ACCORDING to *The Mining Review,* "most of the 'ore' in which gold was reported by the assayer who started the rush, when examined by reputable mineralogists, was described as hyperseane andesite, which can be found in enormous quantities in all parts of the Cascades."

* * * *

Prospector Derives Unusual Value From Course in Horticulture

RECENTLY, Dr. Francis A. Thomson, dean of the School of Mines at the University of Idaho, in addressing the Spokane Rotary Club on the subject "The Business Man and the Mineral Industry," drew several comparisons between the relative importance of the mineral and agricultural products of the country. In conclusion, he told this one:

"Let me tell you a story of an old Kaslo prospector, who passed to his reward a week or so ago. When I was at Washington State College he came down there to take a miner's short course and enrolled at the same time in a short course in horticulture. When his horticulture course was over, I said to him, 'Well, Mr. Winstead, you got a good deal out of your horticulture course, did you?' 'Yes, sir,' he replied; 'taking that course is the most valuable thing I ever did in my life. I have learned that raising apples is a damned sight more risky than mining. I'm going back to mining.' "

* * * *

Electric Power and Ajo

REPRESENTATIVE LEWIS W. DOUGLAS, of Arizona, who happens to be a grandson of the late Dr. James Douglas, talked on "Hydro Power as a Natural Resource" at the recent convention of the American Mining Congress in Washington. Looking ahead in an attempt to vision the future use of the electric current, Mr. Douglas said:

"In mining will we not see, perhaps, an electric arc with some cheap oxidizing and reducing agents replacing coal and oil; will we not see costs come down and percentages of waste in ore go up? The Spanish fathers of the eighteenth century, with their sense of acquisitiveness and love of adventure, were probably not the first ones to extract small tonnages of scattered high-grade copper ore from the low-grade deposits of Ajo, Arizona. The sagas, expanding in extravagance with time, of the rich cupriferous veins of Ajo were the lodestones which drew John Riley from Nevada to Arizona, where he found the tales of Ajo to be untrue, but the facts of the Copper Queen at Bisbee to exceed the dreams of the almost extinct prospector. Ajo did not and could not become a mine of importance until the New Cornelia Copper Company, under the guidance of John C. Greenway and Dr. L. D. Ricketts, successfully applied the electric current to the metallurgy of its low-grade ores. May not the application of the same energy bring into the field of profitable enterprise deposits which are now considered to be above the margin?"

USEFUL OPERATING IDEAS

Notes on Classifier Design

By Harold A. Linke
Utah Copper Co., Garfield, Utah

In the design of classifiers of the Dorr type, screw classifiers of the Akins type, and the Esperanza classifier, there are points which are common to all three. Before building a classifier, several factors ought to be determined for design—namely: tons original feed, tons circulating load, per cent +65 mesh (or "oversize") allowed in the overflow and per cent solids desired in the overflow.

Consider the principal points in connection with the design of a drag type classifier:

The width of the machine ought to be sufficient to enable the rakes to push over all sands when operating on maximum tonnage with sands not more than 80 per cent up on the rake leaves, at a rake speed of not more than 16 r.p.m. The width of the machine, which also means the length of overflow weir, ought to be such that the depth of pulp flowing over the weir does not exceed $1\frac{1}{2}$ in.

The speed of 16 r.p.m. is slower than that used in many mills; reduced speed has a tendency to reduce surging of pulp in the drag pan, and, because of the accompanying reduction in pulp agitation, needs much less water in the classification operation.

It is preferable to use a wide rake on some counts and a narrow rake on others. For example: In a drag 12 ft. wide, four 3-ft. rakes are preferable to six 2-ft. rakes because the number of rake-leaf renewals is as 2:3 and maintenance cost is therefore less. On the other hand, if power is interrupted and the drag goes down under full load, it is found that the wide-rake drag must be washed out almost entirely before restarting, whereas the narrow-rake drag can be started without serious danger with the pan about one-fourth full of sand. I believe the advantage lies in the narrow rakes.

The slope of the rakes and pan bottom is found, in practice, to give drier sands with minimum allowable slip-back on $3\frac{1}{2}$-in. to the foot on Bingham porphyry ores. This is a point which ought to be determined in each case in the field prior to designing a drag. Softer ores will require a flatter slope; and a slightly steeper slope may perhaps be desirable in treating harder ores.

The length of the rakes and consequent length of drag body (or pan) is dependent on the depth of pulp in the pan at the overflow end. This depth in turn is dependent on the volume of pulp which must be maintained in the pan. This volume is determined as follows:

1. Determine the width of the drag as noted above.
2. Determine the bottom slope.
3. From the accompanying chart pick out on the left side the percentage +65 mesh material allowable in drag overflow. Follow this over to the right to the point of intersection with the curve; then, at the bottom will be found the allowable tons of drag feed per cubic foot of classifier settling volume. This "tons per cubic foot," which we will call A, is the total feed entering the drag and therefore comprises original feed and circulating

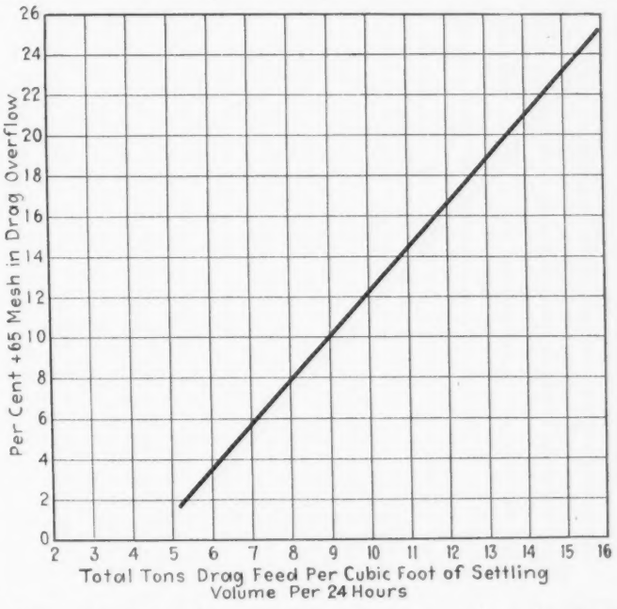


Chart for determining settling volume required for drag

load. Dividing the total tonnage that passes through the drag every 24 hours by A gives the total settling volume required for the drag in cubic feet.

Example

The average percentage of +65 mesh material in the drag overflow is 6 per cent. Referring to the chart, this corresponds to a total feed of 7.2 tons every 24 hours per cubic foot of drag settling volume. Now, the tonnage of original feed to the drag is 450, the circulating load is 300 per cent, or 1,350 tons, making a total load to the drag of 1,800 tons. Therefore the required settling volume for the drag is $\frac{1,800}{7.2}$, or 250 cu.ft. The bottom plane of this volume passes through a line halfway up on the rake-frame angles when the rake is in its low position. Weir height may now be determined.

The accompanying chart is based on feed and other factors, approximated as follows:

		Dry Tons per 24 Hours	Solids per Cent	Partial Screens (per Cent) +65	+200	−200
Original feed (*a*) to drag	Min.	177	.....	54.57	74.01	22.00
	Max.	464	.....	63.31	78.00	25.99
Total feed to drag	Min.	395	40.95	51.62	71.97	21.39
	Max.	1805	56.39	63.96	78.61	28.03
Weir overflow	Min.	177	14.24	3.26	40.76	48.85
	Max.	464	28.86	19.85	51.15	59.24
Drag sands (to ball mill)	Min.	218	72.53	77.41	93.63	5.79
	Max.	1358	75.67	84.77	94.21	6.37

(*a*) Original feed passes through 8-mesh and 10-mesh screens in roll grinding circuit.

Shop Layout for Steel Sharpening

Equipment of a mine blacksmith shop should be so arranged that the drill steel will require a minimum of handling in its travel from entrance to exit. The accompanying sketch has been prepared by the Ingersoll-Rand Company to show how its machines should be arranged.

The necessary steps in the working of drill steel (either bitting or shanking) are as follows:

1—To the oil furnace. Here the dulled steels are given the forging heat.

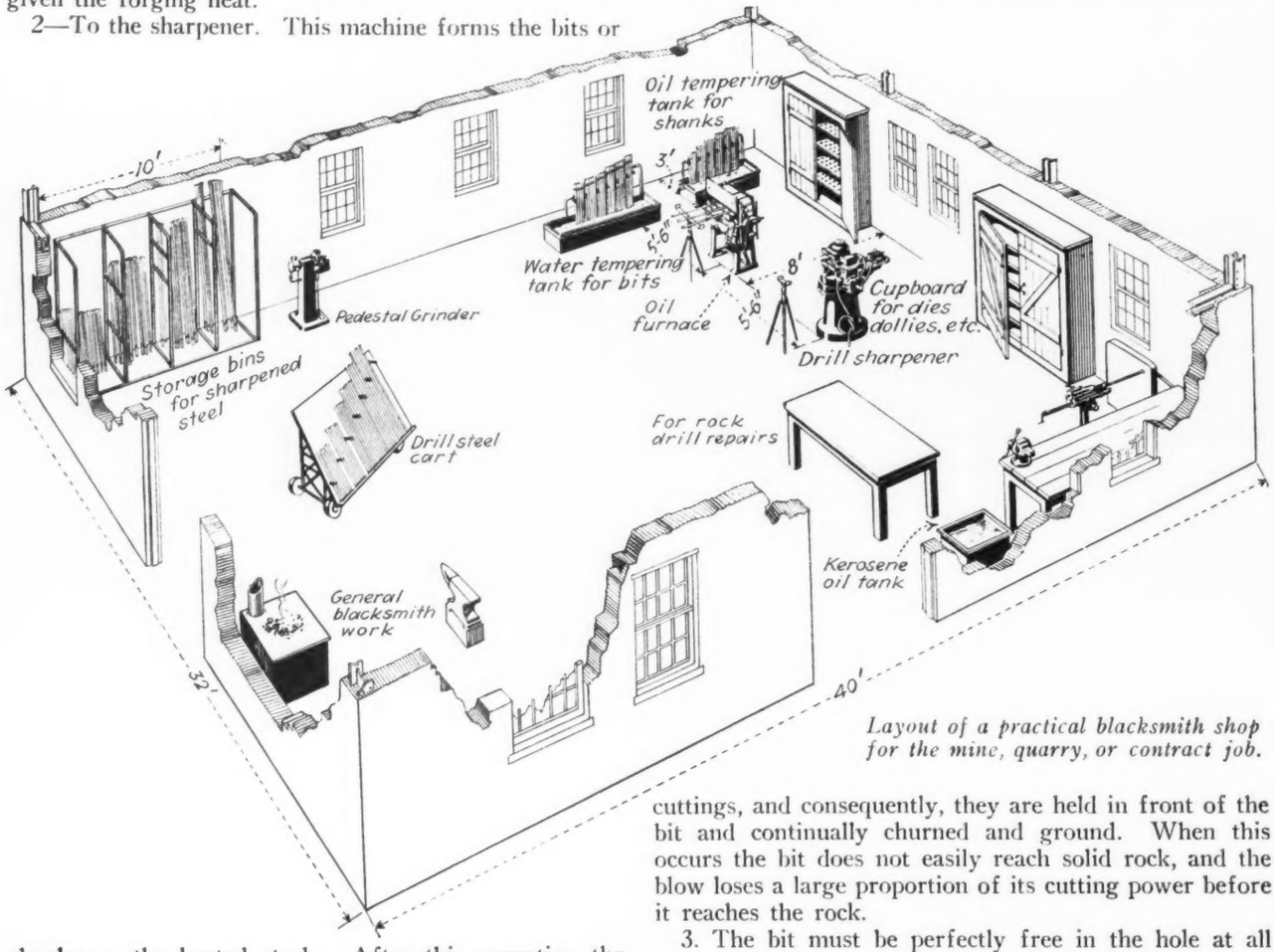
2—To the sharpener. This machine forms the bits or shanks on the heated steels. After this operation the heated steels should be allowed to cool in the air. They may be thrown on the ground or placed in a drill steel cart while cooling.

3—To the oil furnace. The steels are now reheated for tempering.

4—To the tempering tank. Here the heated steels are given the proper hardness. The bits are tempered in brine and the shanks are tempered in oil.

5—To the pedestal grinder. This machine trues up any uneven ends on the shanks of the tempered steels.

6—To the storage bins.



Layout of a practical blacksmith shop for the mine, quarry, or contract job.

What Constitutes a Good Bit?

The consensus of opinion as to what constitutes a good bit for power-drilling work is that, under average conditions, it should embody the following points:

1. It must take full advantage of the chipping and fracturing of the rock. In a bore hole there is a certain depth to which rock will fracture when struck by a sharp tool. If the tool is driven deeper than this, it will not fracture the rock—it will crush it. If the cutting edge of the bit is blunt, it will not get the full benefit of the fracture, and a great deal of the force will be expended in crushing or pulverizing. The bit should act as a wedge.

2. The wings of the bit should be as thin as it is possible for them to be without loss of stand-up quality. On the other hand, they should not be so thick that they prevent free ejection of the cuttings. If the wings are too heavy, however, there is little space for the escape of cuttings, and consequently, they are held in front of the bit and continually churned and ground. When this occurs the bit does not easily reach solid rock, and the blow loses a large proportion of its cutting power before it reaches the rock.

3. The bit must be perfectly free in the hole at all times. Because of the tendency of the rock to fracture, the drill hole will be a trifle larger than the cutting edge. If the bit is so designed that the cutting edge has the same diameter as the distance between the diametrically opposite corners, and if it stays in this condition until it is dull, it will always remain free in the hole.

4. The bit must allow equal wear on all corners. If the bit is not symmetrical—that is, if the ends of all the cutting edges are not the same distance from the center of the bit—the longest end will cut a groove on the side of the bore hole. Hence a rifled hole will result. Furthermore, the wear is unequal, and the extra strains in the steel often break it. The rotation of the drill is impeded, and the parts of the machine are subjected to excessive wear.

5. The bit must be dressed in a manner consistent with the treatment of good steel. It must not be overheated or worked while too hot. Light, rapid blows should be used in forging. The bit must be tempered properly. It should be allowed to cool thoroughly after forging and should then be reheated for tempering. It should not be sharpened and tempered on the same heat.

NEWS OF THE WEEK

Summary

MINERALS and metals division of the economics branch of the Bureau of Mines is subdivided into the common metals division and the rare metals and non-metals division, in charge of C. E. Julihn and F. L. Hess, respectively.

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Dwight W. Morrow, American Ambassador to Mexico, will report on the Mexican situation to President Coolidge at Key West in January on the occasion of the President's visit to Havana, according to unofficial reports.

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Slag-treatment plant of the Anaconda Copper Mining Company erected at East Helena, Mont., to recover zinc from slag is ready for operation and will have an initial daily capacity of 200 tons of slag.

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Native labor situation on the Rand and the working of mines above the average grade of ore reserves are set forth as possible reasons for the continued decline in Kaffir shares on the London market.

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Excitement on the Standard Stock and Mining Exchange of Toronto subsides to considerable extent with sales continuing at the rate of about 1,500,000 shares a day.

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Delays in delivery of structural steel retard construction of mill at the property of the Coniaurum Mines, Ltd., in the Porcupine district of Ontario.

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Work of dewatering the old Cliff and Phoenix properties in the Michigan copper district will most probably continue until next spring.

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Gold strikes are made at several Arizona properties, including the old Christmas Gift mine, 30 miles southwest of Casa Grande.

Photo courtesy Lieut. Ben H. Wyatt, U.S.N.

Along the Alaska-Canada boundary

Gold-Quartz Mining in Alaska Receives More Than Usual Attention

New Activity in Dredging During Last Season Suggests to Operators the Possibilities of Lode Mining— Extensive Aërial Surveys Made

IT IS notable that during the last season more attention than usual was given to the investigation of the gold-quartz mining possibilities of Alaska. The activity in dredging has apparently suggested to mining companies and promoters that, since the placer gold has been derived from lodes, the territory should have possibilities for gold-quartz mining.

The Kassan Gold Company's mill on Prince of Wales Island is treating quartz carrying good gold mineralization. A five-drill compressor is being installed to enable the management to employ a larger crew. The power plant has been increased by the addition of a new 100-hp. semi-Diesel engine of the Fairbanks-Morse type. The company's headquarters have been moved from Seattle to Spokane. Mountain View Gold Mining Company, of Ketchikan, which is developing a mine near Hyder, states the grey copper vein has been cut at a depth of 400 ft. by a 1,882-ft. crosscut tunnel. The vein is well mineralized, but assay reports of sampling are not yet available.

Haley mine, at Silver Bay, Chichagoff Island, stated to have been the first lode-gold discovery in Alaska, is being actively developed by E. P. Preble, of Portland. Results warrant the announcement that by the beginning of the new year steps will be taken either to ship ore or to put in a mill. W. B. Hancock has bonded the Knowles-Backman gold-quartz group, at Teikel, and other quartz claims in the Copper River country, with a view to enlisting Eastern capital in their development. Over 3,000 tons of dredging machinery consigned to the Fairbanks Exploration Company was recently delivered at the Seward terminal of the Alaska railway. The Lucky Strike mine, at Hope, Kenai Peninsula, has been dropped by the Alaska Hills Mining Company, and has reverted to the former owner, J. Hershey, who announces his intention of resuming development and operating the five-stamp mill.

During the current year, considerable progress has been made by the U. S. Geological Survey in the development of aerial photography in connection with

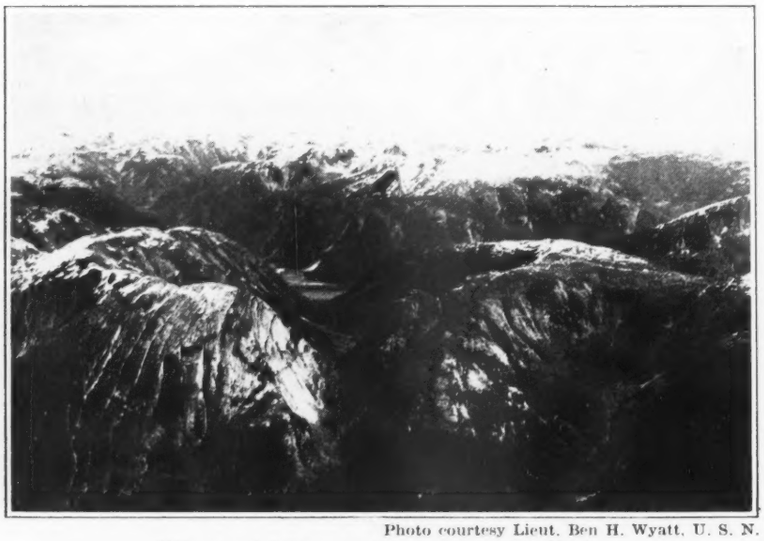


Photo courtesy Lieut. Ben H. Wyatt, U. S. N.

What aerial "prospecting" reveals in Alaska

topographic mapping. In Alaska, two large and hitherto unexplored areas were studied and mapped, and progress toward a map was made in the compilation of aerial photographs of southeastern Alaska taken by the Navy Department. The accompanying views were taken in the course of this work by Lieut. Ben H. Wyatt, U.S.N., who was in charge of naval reconnaissance in Alaska and Colorado.

Alaska Range Mining & Development Company has been organized at Anchorage to develop the recent discoveries of gold-quartz on Valdez Creek. J. Murray, who operates hydraulic plants on Cache and Nugget creeks, reports a short season's washing. He is testing his ground on Cache Creek with a view to utilizing the dredge which he purchased last year. The miners who lost out through the failure of the McKinley Gold Placers Company, took over the ground and made a considerable gold production for the past season, even though they were late in getting a start.

A new drifting plant has been installed on the Jessen ground on Ester Creek at Fairbanks. It consists of 60 tons of machinery, including 30- and 40-hp. boilers. Depth to bedrock is from 90 to 100 ft. According to report, the 5,000-hp. hydro-electric plant of the Fairbanks Exploration Company has been completed at a cost of around $1,000,000. The 100-mile ditch line is nearing completion with the installation of the last of the 7 miles of siphons. The two-mile tunnel through the Cleary Dome is the last piece of work on the job, and that will be through by spring in readiness for the start of the season's operations.

An English company has acquired from S. Howell 60 claims on Sullivan Creek, Hot Springs district, with a view to testing the ground for gold and tin. The same interests have taken up 6 miles of dredging ground on Kokomo Creek and some gold-quartz claims on Fourth of July Hill. They have made the second payment on the Ryan lode-gold property, where they propose to establish a large stamp mill. They are also investigating the silver-lead deposits on the Kantishna River, a tributary of the Tanana. The deals were made on the report of C. J. Inder, of London. The Lewisohn interests, of New York, have taken options on dredging ground on Fish, Ester, and Fairbanks Creeks, with a view to testing it by drilling.

A new placer strike is reported from the Agate Fork at Ophir. The Peck dredge, on the Casadepaga River, had a good season, but as the ground has now been worked out the dredge has been sold to V. C. Shafer, who has holdings on the river. Iditarod miners report a good production of gold for the season. Water was plentiful everywhere with the exception of Chicken Creek. The Riley Investment and American Dredging plants on Otter Creek were able to work later than usual.

The Joaquin dredge on Gaines Creek, in the Ophir district, has been purchased by H. Erickson. The Flume Dredge Company reports a successful season for its plants on Yankee and Little Creeks. Dredges on Gaines and Candle Creeks were idle for the past season. E. Hart's drag-line plant operated successfully at Ophir, and he is putting similar plants on the Greenburg and Wilson ground which he has acquired on Cripple Creek. D. Thompson has been hydraulicking a bench on Spruce Creek, and N. Beebe worked a scraper plant on Little Creek.

Nome is likely to enter a new mining phase, there being considerable development going on with a view to establishing a gold-quartz production. Promising quartz discoveries under development are: Snow Gulch; Connolly's; Strand and Hed; Big Hurrah, in Solomon valley; Meegan mine, at Bluff; and the Sligcovich antimony mine. The Meegan mine is on the coast at Solomon, and has recently been equipped with a new plant. It has been a profitable producer for the last ten years.

The Riverside mill, at Hyder, has been closed down for the winter. Development will be pushed forward to provide a reserve for next summer's milling operations. A new orebody carrying good mineralization has been struck, and this, with the scheelite deposit traceable to the surface, improves the outlook for the property.

The Hecla Mining Company, of Idaho, has expended $300,000 in the last three years in drilling the Parkins ground on Birch Creek, at Circle, and is arranging to send in between 600 and 700 tons of dredging machinery to be hauled by tractors from Chatanika station on the Alaska Railway to the site of operations, a distance of 126 miles.

Photo courtesy Lieut. Ben H. Wyatt, U. S. N.

A forest covered terrain in Alaska

Several Gold Strikes Made at Arizona Properties

Finds in Casa Grande and Wickenburg Districts—Repairs of Fire Damage Begun at Magma Mine

A GOLD strike has been made at the old Christmas Gift mine, 30 miles southwest of the town of Casa Grande along the Southern Pacific Railroad. The strike was made by "Charley" Eastman, an old time prospector and one of the owners of the property. The Christmas Gift first came into prominence in the '80s, when Major Burnham, in company with an associate, while mining high-grade lead stringers for shipment to the Selby smelter, accidentally uncovered a body of gold ore within 12 ft. of the surface. Ore valued at $50,000 was taken from this small deposit, but extensive development work later failed to reveal a continuation of the orebody. The ore occurred in a calcite-quartz matrix between large limestone boulders. Believing that a fault, some distance to the south of the high-grade deposit, was the original avenue along which the deposits were made, Mr. Eastman followed a small stringer, located near the original find in that direction. Within the fault, near a porphyry intrusion, the stringer widened out, and it was at this point that the new find was made. Further development work is now being done to prove the extent of the ore.

Another find recently made in the district is about 9 miles from the Christmas Gift, where gold is being found in the form of tellurides at a depth of 500 ft. This is the deepest working in the Casa Grande mining district. Tellurides were also discovered in the upper levels by geologists who examined the property. The average values of these telluride ores will not be known until the exploration work at depth which is now in progress is adequately advanced.

The old Vulture mine near Wickenburg is being operated by Dan R. Finlayson and some Connecticut associates. The mill is running 24 hours a day, and bullion is being shipped every ten days to the United States mint in San Francisco. Water is being pumped from the mine for use in the mill, and the water level in the mine is now below the 600-ft. point. Good gold ores are still being mined on the 600 level, and development work is now in progress on the 300 level. The Vulture Extension Mining Company has purchased a mine north and adjoining the old Vulture. This property has two veins striking southeast and carrying good gold ore on the surface. Ground has been broken for a shaft, which will be sunk to a depth of 300 or 400 ft., after which the veins will be explored by drifts. A. P. Irvine is superintendent at the Vulture. Wiley A. Hansen is in charge of operations at the Vulture Extension.

Another Maricopa County mine which recently became a producer is the Tonopah Belmont, at Camp Belmont. This mine is shipping each month concentrates valued at approximately $75,000. Production for September and October amounted to 1,200 tons of concentrates.

Reconstruction work has started at the mine of the Magma Copper Company in the Superior district, recently swept by a disastrous mine fire, which resulted in the loss of seven lives and considerable property damage. Six bodies have been recovered, but the seventh, that of an Apache Indian, who, after reaching safety, re-entered the mine in the hope of leading his lost companions to safety, has not yet been found. It is believed that when the cage in which he was attempting to reach the lower levels fell to the bottom of the shaft, after the cable gave way, he was drowned in the sump. The walls of No. 2 shaft are reported to be badly caved as a result of the fire, and it will be necessary to replace approximately 1,000 ft. of timbering before work can be resumed. In the meantime, some ore is being hoisted through No. 3 shaft.

As a result of voluminous agreements recently filed with the Yavapai County Recorder, the United Verde Copper Company and United Verde Extension Mining Company, whose properties in the Jerome district adjoin each other, have agreed to forever surrender the right to follow ore upon its dip beyond the boundaries of their own properties into the property of the other company. This is in the nature of what might be called a "side-line" agreement and was executed several months ago, but not filed until recently. This action bars any possibility of apex litigation, which has caused so much trouble in other camps. Somewhat similar agreements have been in effect for many years in the Bisbee district, which has been free of the litigation which has caused such trouble along the lode in the Globe district.

THE Belmont Copper Company, in the Superior district, reports a rich strike of silver on the Eureka vein, in a crosscut from the 1,600 level of the main shaft. At the point of opening, the ledge is said to run between 4 and 5 ft. wide, and carries a pay streak 2 ft. wide. Between 75 and 100 men are employed at the Belmont, and this force will be considerably increased as soon as the mill is constructed. About 75,000 tons of good milling ore is said to have been blocked out.

Montana Mines Operations, a subsidiary of the Eagle Picher Lead Company, is erecting a 200-ton flotation mill at the Montana mine near Ruby, Ariz. The plant will be completed in March, 1928, and will cost about $100,000. A steel headframe and a double-drum hoist are also to be installed. Deepening of the shaft will start when the hoisting equipment is in place. Development work is being carried on by a crew of 25 men. Frank H. Lerchen is general manager of the property.

Tonopah-Belmont Development Company, in the Wickenburg district, is shipping concentrates at the rate of $75,000 a month.

More California Properties to Be Reopened

Considerable New Activity Prevails in Many of the Metal Mining Districts of the State

RUMORS are current that Boston interests are to reopen the Utica mine at Angels' Camp, Calif. The scheme involves the Carson Hill Gold Mining Company's proposed program of a central milling plant at Melones and the reopening of the Utica, Angels, and Lightner mines at Angels' Camp.

The Moore Mining Company, near Jackson, Calif., reports the opening of its 2,100 level, but no ore was found and the mill has been shut down. Work is being continued on the 1,800-level west crosscut, which is being driven toward the South Jackson vein. Near Pine Grove, the Yellow Tiger Consolidated Mines Company is operating the Pioneer mine. The King Solomon, Spagnoli, Acondi, and other properties are active. A hoist, mill, and equipment are being installed at the Spagnoli.

Practically all of the parts for two gold dredges, together with power-plant equipment, were shipped late in November from San Francisco, consigned by the Bethlehem Shipbuilding Corporation to the Fairbanks Exploration Company, a subsidiary of the U. S. Smelting, Refining & Mining Company. The dredges are to be constructed and placed in operation on the placer holdings of the company in the vicinity of Fairbanks, Alaska.

The Estabrook gold dredge is being dismantled by the Estabrook Gold Dredging Company, at Trinity Center. In Shasta County, along the McCloud River, a group of mining claims has been obtained under option by W. E. Trent, of New York, and is being explored under the name of the McCloud River Copper Mines.

At Forest Hill, the Four Aces is continuing to mill ore of good grade. The Belcher Extension Annex Company, southeast of Auburn, has placed its mill in operation on the Lady Bug mine. The Harmill Divide Company is reported to be operating a 50-ton mill on its La Trinidad mine, in the Sailor Flat district.

At Mammoth, Mono County, the Mammoth Consolidated Mines Company is rehabilitating the old Mammoth mine and claims to have made several ore discoveries upon the surface and in old workings.

Cherry Hill mine, west of Williams, Colusa County, has plans under consideration for the construction of a 250-ton mill. The property is operated by the Gold Mountain Mines Company.

Another effort is to be made to mine at Meadow Lake, Placer County. W. H. Bray is stated to have secured control and to have made new locations.

The University Mining Company is reported to have taken a lease on the Chemung mine, at Masonic.

Minerals and Metals Division of Bureau's Economics Branch Subdivided

One Part to Be Known as the Common Metals Division and the Other the Rare Metals and the Non-Metals—C. E. Julihn and F. L. Hess Chiefs of Respective Divisions

By Paul Wooton
Special Washington Correspondent

THE minerals and metals division of the economics branch of the U. S. Bureau of Mines has been subdivided. One part will be known in the future as the common metals division and the other the rare metals and the non-metals division. In addition to these divisions the economics branch has divisions devoted to petroleum economics, to mineral statistics, and to coal.

The work of the rare metals and non-metals division will be carried on by F. L. Hess as its chief engineer. C. E. Julihn, formerly the chief engineer of the Bureau's information division and its copper specialist, will be in charge of the common metals division. The common-metals division will deal with gold, silver, copper, nickel, aluminum, lead, zinc, iron, chromium, manganese, tin, pyrite, and sulphur. The rare metals and non-metals division will deal with antimony, arsenic, beryllium, bismuth, cadmium, cerium, cobalt, columbium, gallium, germanium, indium, iridium, lithium, mercury, molybdenum, osmium, platinum, radium, rare-earth metals, rubidium, selenium, tantalum, tellurium, titanium, tungsten, uranium, vanadium, zirconium, stone, gravel, sand, gypsum, slate, limestone, cement, magnesite, potash, phosphorus, nitrates, salt, soda, borax, strontium, clays, shales, fuller's earth, bentonites, diaspore, sillimanite, cyanite, andalusite, dumortierite, graphite, quartz, feldspar, iron minerals for paint, barite, asbestos, talc and soapstone, emery, corundum, garnet, tripoli, diatomaceous earth, mica, and fluorspar.

Budget Carries $50,000 Item for Economics Branch

The budget for the coming fiscal year carries an item of $50,000 for the economics branch of the Bureau. It is assumed that this sum is intended for a study of vanadium, chromium, nickel, manganese, quicksilver, antimony, and tungsten—so-called strategic minerals. The War and Navy departments are interested in both the domestic and foreign sources of supply of such minerals and the resources of these materials available for use in the future.

In addition to the desire of the military branches of the government for more information concerning these minerals, there is also a demand for research along those lines from the industry. Requests have been made of the Secretary of Commerce for this work, and it is understood that the problem was assigned to the Bureau of Mines. It seems probable that there is some connection between that demand and the further subdivision of the metals division of the Bureau.

The undertaking of this work had no bearing on the creation of a separate minerals division in the Bureau of Foreign and Domestic Commerce. The impression seems to have gone abroad that J. W. Furness was transferred from the Bureau of Mines to the Bureau of Foreign and Domestic Commerce to handle that work. It is known that officials of the Bureau of Mines regarded Mr. Furness as being particularly well equipped to handle that phase of the work, but they have taken steps to build up a strong personnel for the world studies and for more intensive work on the strategic minerals and other important metals and non-metallics.

Fifth Potash Drilling Finished

On reaching a depth of 1,791 ft. the Bureau of Mines suspended drilling on its fifth potash well in the Southwest. This well is on the Harris ranch, in Crockett County, Tex. In this instance a churn drill was used to a depth of 1,161 ft. a point near the top of the salt bed. From that point downward a diamond drill was used and a complete core recovered. This is regarded as particularly good work on the part of the drillers, as the hole was sunk in difficult ground. This is the second of the five holes from which 100 per cent of the core has been recovered. In another case, 98 per cent of the core was brought to the surface in good condition; and 94 per cent was the lowest recovery in any of the wells.

The Pennsylvania Drilling Company, of Pittsburgh, was successful, among four bidders, in securing the contract for the next two holes, which are to be put down near McCamey on the Kansas City, Mexico & Orient Railroad.

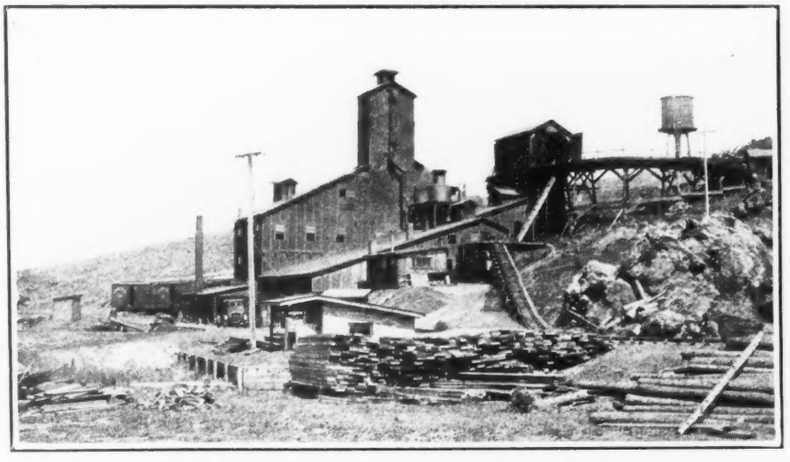
Operations in Montana Continue to Expand

Slag Treatment Plant at East Helena Completed—Trout Company May Re-Mill Tailings

THE slag-treatment plant of the Anaconda Copper Mining Company erected at East Helena to recover the zinc in the slag pile and current slag of the East Helena plant of the American Smelting & Refining Company is ready for operation and will treat approximately 200 tons of slag per day. The process to recover the metallic content was developed by U. A. Garred and Frederick Laist, general metallurgical manager of the company.

Montana-Idaho Mines Corporation is remodeling and increasing the capacity of its Kleinschmidt mill, near Winston, Broadwater County. The company has purchased a caterpillar tractor to haul ore and concentrates from its Winston properties to the mill. The orebody encountered on the East Pacific No. 6 level has materially increased in length on the No. 7, and a shaft is being sunk to the No. 8 level. The mill building at the company's Spring Hill property in the Helena district has been completed and is ready for the installation of machinery. This cyanide plant was originally designed for 150 tons per day, but will handle 200 tons, and there is said to be enough ore in sight to run the plant for five years. The plant should be in operation before the end of January. H. F. DeBower, president of the company, and a group of Eastern business men are now in Montana inspecting the company's properties.

Operations at the 100-ton mill of the Trout Mining Company, at Philipsburg, are proceeding steadily, and extraction of chemical manganese ore from rhodochrosite ores is averaging about 80 per cent. Recently, the re-treatment of the tailings on the property was considered, and tests made indicated that the present extraction might be raised to 95 per cent by such re-treatment operations.



The Trout Mining Company's concentrator at Philipsburg

Dewatering of Two Properties in Michigan Copper District a Long Task

Work of Draining and Repairing Shafts in the Old Cliff and Phoenix Mines to Continue Until Spring—Advance in Metal Market Heartens Seneca Stockholders

WORK of draining and repairing shafts in the old Cliff and Phoenix properties in the Michigan copper district, which will be used by Calumet & Hecla Consolidated for exploratory purposes, is a considerable task in view of the depth of the shafts, extent of the openings, and the many years the mines have been idle. Actual exploratory work probably will not be possible in Cliff until spring, and more time may elapse before such operations are undertaken in Phoenix. In Cliff, about 600 ft. remain to be drained in No. 4 shaft. Below the 13 level, the levels are only 60 ft. apart. Some of them are quite long, and considerable stoping was done, which indicates that a large volume of water remains to be removed. The Avery shaft will be used as a supply and pump unit. Two shafts are being dewatered at Phoenix through an incline shaft, which is 2,600 ft. in depth. Water from a shallow vertical shaft drains into the incline through a connecting crosscut. The deep shaft is drained only to the 4 level. Extensive repairs will be necessary in this unit. Although the presence of regular veins would be more desirable and permanent, it is likely that some of the fissures, in which mining was confined in the early days of the district, will be given attention through extension of openings.

In addition to Cliff and Phoenix and a crosscut which Calumet & Hecla is driving from Allouez No. 2 shaft, the only other exploratory and development projects being carried out in the Michigan copper district are the Mayflower-Old Colony and Arcadian Consolidated operations. With the strengthening of the copper market, there is speculation as to other properties which could be reopened under the stimulus of a strong metal demand. The list appears to be limited. It is confined to Seneca, in Keweenaw County; Franklin and Winona, in Houghton County; and the Michigan, in Ontonagon County. Among the producing mines, however, there are idle shafts which could be worked if warranted.

The advance in the copper metal market has heartened Lake stockholders of the Seneca Copper Company, who believe a better price may lead to the reopening of the mine. If copper goes to 15c., Seneca could break even, if it started with a "clean sheet"; and at 16c. it could make a fair profit. A great deal of money and time was required to develop Seneca, and the property was getting ready to go into larger production, with a consequent decrease in costs, when it met with financial difficulties, resulting in a shutdown. Seneca is handicapped in comparison with other mines in the Michigan district in that it has no stamp mill, smelter, or railroad, and is compelled to pay a high rate of transportation on coal. On account of this lack of plant equipment, it is believed the property could be more advantageously worked by one of the other companies.

In Quincy No. 2 shaft, which is being retimbered through the section damaged by fire last July, repairs have reached a point below the 41 level, the timber crews having safely rebuilt the shaft where cave-ins resulting from air blasts recently caused the death of seven workers. It is believed the most dangerous part of the work has been done. The remainder of the retimbering, however, will be slow, as there is considerable rock in the shaft. The damage extends to the 53 level. Three crews are being employed, so the work will be continuous. Quincy has let out a number of men, owing to the fact that it is producing only from the area served by No. 6 shaft.

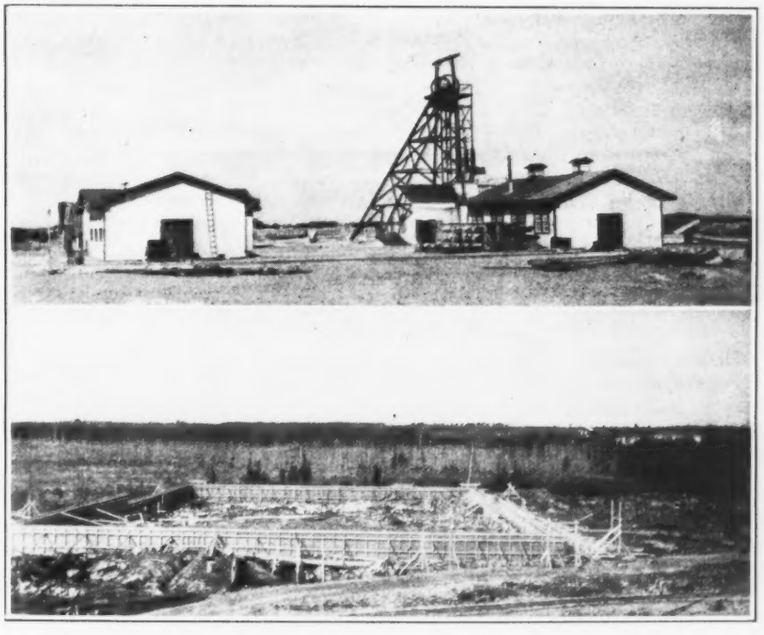
To facilitate pumping in the conglomerate department of Calumet & Hecla Consolidated, an electric pump will be installed in the 91 level of No. 4 Calumet shaft to handle excess water from the North Tamarack. The water will be raised to the 57 level, through which it will flow to No. 5 Tamarack, to be pumped to the surface. No. 4 shaft, idle since the fire in this unit in 1924, will most probably be ready for sinking operations within 60 days.

More Information on Gold Find at Benguet Mine

In the Oct. 8 issue, *Engineering and Mining Journal* published a report of a gold strike in the Philippine Islands at the Benguet mine of the Benguet Consolidated Mining Company, which report stated that armed guards and barbed-wire entanglements were placed around the shaft entrance, and that the strike was kept secret for two weeks while the company bought up practically all of the outstanding stock. James S. Colbath, assistant general manager of the company, in a recent letter, writes that armed guards and entanglements were not used, and that neither the company nor any one connected with its management has ever purchased stock before announcing particulars of favorable development. *Engineering and Mining Journal* is glad to take this opportunity to publish the correction supplied by Mr. Colbath.

Steel Deliveries Hold Up Progress on Coniaurum Mill

Owing to delays in the delivery of structural steel, slower progress than was expected is being made with the construction of the mill at the property of Coniaurum Mines, Ltd., situated at Schumacher, in the Porcupine area of northern Ontario. The foundations for the mill are all completed and erection of the framework should be well under way early in the year. At present, it is hoped to complete the construction of the mill by next April.



Above—Surface plant at the Coniaurum shaft
Below—Construction of mill foundations

The work of deepening the shaft to the 2,000-ft. point has been finished, and drifting is in progress on the 1,750 and 2,000 levels toward the downward continuation of the orebody.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Excitement on Exchange Subsides—Seat Sells for $60,000

TORONTO, DEC. 10—The excitement on the Standard Stock and Mining Exchange at Toronto has subsided to a considerable extent, although sales are still running at over 1,500,000 shares a day. Brokers, however, are confident that the strong markets will continue. This is evidenced by the fact that a seat was recently purchased for $60,000, a new record price, being $10,000 in excess of the previous high price.

During the month of November, the Lake Shore Mines of Kirkland produced $350,000 from ore averaging $17 to the ton. This is a substantial increase in output and grade, although the tonnage remains practically the same. An extra tube mill is now on the property, which, it is expected, will bring the mill capacity up to 900 tons a day. It is understood that production during December will be at least equal to that of November as the grade has been as high as $20. Good progress is being made with the new shaft and toward the end of the present winter it should be completed to the 800-ft. level. Gross production during the present year should be over $3,000,000.

THE annual report of Teck-Hughes Gold Mines for the year ended Aug. 31 last shows that 114,765 tons was treated, the production being $2,105,545. The average grade of the ore was $18.35; costs were $8.41, and net operating profits before taxes, $1,058,363. This is an increase of over 40 per cent in tonnage and profits, the grade of the ore being the same as for the preceding year. During the year, $561,000 was expended on permanent plant, so that the cash position stands at $1,305,654, a decrease of $126,000 compared with the preceding year. In addition to the direct operating costs of $8.41 a ton, depreciation amounted to $1.19 a ton, bringing the total of direct and indirect charges to $9.60 and leaving a net operating profit of $8.75 a ton. During the year, the shaft was deepened from the 13 to the 19 level, the latter level being 2,230 ft. from the surface. As a result of the year's mining operations the tonnage of ore extracted was more than replaced in reserve by blocked and broken ore, and the quantity of broken ore in reserve was approximately doubled. In the general manager's report he refers to the high price of power, regarding which negotiations are now under way. The average daily tonnage treated during the year was 320. Information on the mine was brought up to date at the annual meeting held in Buffalo, Dec. 2. At the time the annual report was written, the six new levels, from the 14 to the 19, were just in the preliminary stage, but since that period a total of 1,642 ft. of new ore has been opened up, of an average width of at least 9 ft. and of an average grade in excess of $18. On the 14 level, 503 ft. of ore has been opened in the same length of drifting; on the 15 level, 446 ft. of ore in 446 ft. of drifting; on the 16 level, 247 ft. of ore in 260 ft.; on the 17 level, 260 ft. of ore in 430 ft. of drifting; on the 18, 81 ft. of ore in 180 ft. of drifting, and on the 19 level, 105 ft. of ore in 180 ft. of drifting. Full information as to the average width and grade is not yet available but the width opened up so far will exceed 9 ft. and the average grade will exceed $18. It was also stated that the new mill unit, increasing the plant's milling capacity to 850 tons a day, would be in operation before the close of the year.

Shareholders of the Crown Consolidated have been informed that between the end of May and the end of November 6,500 ft. of diamond drilling was done partly from the surface and partly from the 800-ft. level. Several vein formations from 5 to 20 ft. wide, carrying good gold values, were intersected. The vein system has been proved for a length of at least 2,000 ft., and the formation in which the ore has been found has been proved to a depth of at least 2,100 ft. below the surface, the greatest depth reached by the drills. In view of these results, a contract has been let to sink the shaft from the 575 to the 1,200-ft. level, and five new levels will be established. Satisfactory financial arrangements have been made and the treasury is assured enough money to carry out this program. The officials have confidence that this proposed work will put enough ore in sight to warrant the erection of a 500-ton mill.

Porcupine Goldfields Development & Finance Corporation has taken an option on the controlling stock of the syndicate that has been operating the Yankee Girl mine, at Ymir, and which during the last two years has been shipping heavily to the Trail smelter. The corporation plans to do considerable development work at the mine, and, if this proves satisfactory, it is probable that a mill will be erected. The syndicate has shipped crude ore, on which it receives a favorable rate on account of the high silica content.

A dispatch from Victoria, B. C., states that an option on the Rufus silver-lead property and the Argenta copper-gold property, in northern British Columbia, has been taken by the Noranda Mines, Ltd. The two properties are being merged on a share for share basis, and the Noranda is stated to have taken an option involving control of the stock of the new company. It is understood that the deal will involve a total of approximately $480,000.

The Pioneer property, in Michipicoten, is under the same management as the Keeley and Vipond, and this company has let a contract to sink a 500-ft. incline shaft on what is known as the Jubilee break. It is expected that sinking will start at once.

London Letter

BY W. A. DOMAN
Special Correspondent

Prices of Kaffir Shares Continue to Decline With Cape Sales

LONDON, DEC. 6—In a recent letter I mentioned a certain amount of nervousness existing among holders of Kaffirs. This has continued, and prices are declining, due partly, it is said, to sales effected from the Cape. Whether this is attributable to the native labor position—and it is believed in some quarters that Portugal would like to force the granting of a loan through pressure brought to bear upon the mines of the Rand—or to the fact, disclosed by the government inspector of mining leases in his annual report, that mining companies have been working above the average grade of their ore reserves, is not clear. Brakpan, especially, has been on tap, and for some time this has been regarded as one of the best properties on the east Rand. The market suggests that the life is only six years. To some extent, the general selling may be the result of the rather hesitating statement of Lord Harris at the recent Consolidated Gold Fields meeting. In speaking of the Robinson Deep mine, he said, "Meanwhile, we have reasonable hope that the Union Government will accede to the urgent appeal from the mining industry to come to arrangements with the Portuguese authorities on such terms as will permit continuous extra territorial recruiting of native laborers, and, given no material falling off in values, we may confidently look forward to enhanced profits from next year's operations."

THE two points fixed upon by the market were those of native labor, and values in the Robinson Deep. This mine has been one of the speculative favorites for a long time, and doubts as to values in it have been applied to other mines. The declaration of the Kaffir half yearly dividends within the next week, or so, is now anxiously awaited.

Another matter that has checked speculation—this time in the Rhodesian market—is the appearance of the annual report of the Bwana M'Kubwa Copper Mining Company. This contains very little information of a technical character, and it is only on examining the accounts that one can get an idea of what working costs have been. The production of copper to Mar. 31 last was 2,297 tons, and the revenue from sales, together with the valuation of metal on hand, was approximately £111,940. This is about £48 15s. a ton of copper, or less than the average price of standard during the period. Operating costs aggregated £184,540 or about £80 a ton for copper recovered. Adding all other charges, the costs are £92 a ton, or a net loss of £44 a ton.

Mexico City Letter

By W. L. Vail
Special Correspondent

Ambassador Morrow to Report on Mexican Situation Early in January

Mexico City, Dec. 7—The American Ambassador, Dwight W. Morrow, is, according to unofficial reports, scheduled to meet President Coolidge at Key West early in January, on the occasion of the President's visit to Havana, to report on the progress made in the Mexican situation. Rumor has it that among other topics to be touched upon is a possible loan of $200,000,000 to the Mexican government; the securing of an additional agrarian bond loan; amendment to the constitution which will remove the friction between the two governments over petroleum; a settlement of the water questions pertaining to the Rio Grande and Colorado rivers; and a possible re-declaration regarding real estate held by foreigners in the prohibited zones adjacent to frontiers and along sea coasts. The ambassador has, as a matter of fact, made long strides, in the relatively short time that he has been in Mexico, towards acquiring the confidence of the Mexican officials and popularity with the Mexicans in general. At no time within the past decade has there been the feeling of optimism relative to Mexican-American relations that exists at this moment. The changed conditions are expected to be reflected in Mexico's attitude at the coming Pan-American congress in Havana.

Efforts are being made by lead and zinc interests to secure a reduction of federal taxes on those minerals and their byproducts. Under the regulations of the decree of April 19, 1927, taxes are based on New York market prices. Operators claim that as practically all the output of the zinc and lead mines go to Europe, the London markets should serve as a base of taxation rather than those of New York. Even the small amount of zinc sent to the United States is only for refining purposes, and is really in transit. The cost of production of lead, it is maintained, also has considerably increased rather than diminished in late years. The Chihuahua mining chamber is taking an active work in the campaign.

The following mine suspensions have been authorized recently by the Department of Commerce, Industry and Labor: El Cometa y Anexas, district Hidalgo de Parral; Santa Elena, property of the Cia. Mineral Fundidadora y Afinadora, Chihuahua; Cia. Minera y Beneficadora del Norte, Zacatecas; La Internacional, district of Doctor Arroyo, Nuevo Leon; the Nayarit property in Nayarit. Temporary suspensions for the purpose of repairs have been granted some properties belonging to the San Rafael interests in the Pachuca camp, State of Hidalgo.

The Berta Mining Company, of Chihuahua, is installing new equipment and expects to be shipping ore soon. The Atlixco unit of the International Ore & Smelting Company, Taxco, Guerrero, has closed its crushing department temporarily. Development work continues. A small smelter is being erected at the Rey del Plata mine, in the State of Guerrero.

The petition of the Dolores Mining Company, of Chihuahua, to the Department of Commerce, Industry and Labor for permission to suspend operations on account of the inability to make expenses has been refused on the ground that a check of the company's books by government experts shows the claim of the petition to be unfounded.

Aurora de Xichu, Zacatecas, is installing a concentrating plant. The mill is expected to be ready for operation by Jan. 1, 1928. Development work is being pushed rapidly in the meantime.

The San Antonio Mining Company, Pachuca, has been reorganized and is now known as the Oracion Mining Company.

The Lampazos Syndicate, financed by American capital, is reported to have acquired recently the old Lampazos group of mines in the State of Sonora, for $500,000. Machinery is now being shipped from Douglas, Ariz., to the property, and will be installed at once.

The Lane-Rincon Mines, Inc., in the Temascaltepec district, State of Mexico, has finished opening up a new orebody and is reported to be in a position to double the volume of its operations. Several smaller properties in the same district are also reported as active.

El Bolero copper properties, near La Paz, Lower California, expects to increase, rather than to diminish, its output during the coming year. The camp is now employing a large number of workmen and has more than 100 men on the office staff.

The lead company at Los Lamentos, Chihuahua, has requested permission from the proper authorities to make a temporary reduction in the working force because of the unfavorable conditions of metal prices.

The Monte Carlo, one of the most important lead-silver mines in the State of Guerrero, has resumed work after a brief shutdown on account of rebel activities. The mine output is now about 60 tons daily.

Cia. Minera de Zimapan, State of Mexico, is reported in excellent condition and rapidly increasing in production. The plant has recently been completely re-equipped.

Frank L. McCaughn, president of the McCaughn Investment Company, of Durango, has started work on the Otaez property in the Otaez district, Durango.

The Santa Maria de la Paz mine, Matehaula, State of San Luis Potosi, is reported to be in bonanza.

Some quicksilver deposits are reported to have been recently discovered in the State of Zacatecas.

Johannesburg Letter

By John Watson
Special Correspondent

October Crushings at the Principal Rand Gold Mines Published

Johannesburg, Nov. 14—The following results of crushings, for October, at eighteen leading Rand gold mines, have recently been published. The mines are arranged in order of profits earned:

	Tons Crushed	Value or Revenue £	Costs per Ton s.	d.	Estimated Profit £
Government Areas	200,000	388,926	16	7.6	225,045
New Modder	134,000	318,156	19	4.8	188,211
Crown Mines	214,000	309,873	20	8.2	88,536
Modder Deep	44,300	99,923	15	4.0	65,940
Springs Mines	67,500	131,629	20	8.8	61,666
New State Areas	74,000	129,271	20	6.7	54,018
Brakpan	77,700	132,097	20	8.5	51,653
Modder "B"	69,000	113,252	17	11.6	51,265
Geduld	84,000	117,433	16	4.0	48,745
Van Ryn Deep	59,000	101,863	18	11.6	47,531
Sub Nigel	19,300	.....	42	7.0	41,852
West Springs	48,400	72,929	19	7.0	25,531
Randfontein Est'te	196,000	197,767	17	9.9	25,528
Langlaagte Estate	81,000	102,014	20	4.5	21,038
Consol. Main Reef	59,000	94,646	25	1.9	20,420
Modder East	59,000	79,092	21	2.2	16,610
Robinson Deep	72,500	.....	20	2.7	16,287
Simmer and Jack	72,200	.....	18	4.8	10,830

The total value of the mineral output of Southern Rhodesia for the month of September was £281,340 as compared with £336,894 for August. The itemized values of the September output included: Gold, £193,646; silver, £870; coal, £35,279; chrome, £1,808; asbestos, £46,732; tin, £450; mica, £2,525; and diamonds, £30.

The Union Department of Mines and Industries has recently issued an interesting report explaining a new geological map of the country round Vredefort and Parys (Orange Free State), which has been compiled by Louis T. Nel, of the geological survey. This district includes a series of conglomerate or "banket" beds, which carry gold values in places. A company named the Blaauwboschpoort Estate and Gold Mining Company, Ltd., was formed in 1889; rich patches of gold and silver were struck, but the distribution of the precious metals was too sporadic to allow of profitable exploitation.

The Sub Nigel, Ltd., have circularized their shareholders to the effect that a new vertical shaft, of about 3,600 ft. in depth, is recommended by the consulting mining engineer, and that it is proposed to increase the capital of the company from £678,750 to £750,000.

It was recently stated that American interests are no longer operating the Postmasburg, Cape Colony, manganese deposits. One of the more enterprising mining houses in Johannesburg at once investigated the matter and secured an option on the deposits.

A diamond of 85½ carats, which was found at Brakfontein early in November, was recently sold in Kimberley for £1,000; another stone of 9¾ carats was sold for £350.

Societies, Addresses, Reports

The Lake Superior Region As a Continued Source of Iron Ore

By Dwight E. Woodbridge
Mining Engineer, Duluth, Minn.

AS TIME passes, it becomes increasingly plain that the predominance of the Lake Superior region as a long-continued source of iron ore can be maintained only through favorable results of scientific study of the ore industry. Round about Lake Superior there are vast quantities of iron-bearing material not now commercial but that it is hoped to make available to steel makers. Though not imminent, the time does approach when these materials must be used if the steel trade is not to suffer. Recognizing this fact, the U. S. Bureau of Mines and the schools of mines of both Michigan and Minnesota have engaged themselves in fundamental studies.

A series of interviews is given below, detailing the aims of these organizations in this research, their results to this time, and the problems they have overcome and still must meet. That for the Bureau of Mines is with T. L. Joseph, supervising engineer at the Bureau's mining experiment station at Minneapolis; that for the Michigan College of Mining and Technology is with President William O. Hotchkiss; and that for the University of Minnesota with Prof. Edward W. Davis, superintendent of its mines experiment station. These institutions have attacked their problems from different points of view, and their combined efforts cover the subject in a broadly scientific manner. Their work is advanced far enough so that the prediction is safe that it is sure to be of incalculable benefit to the industry in general and to the states that Messrs. Hotchkiss and Davis represent.

Cuyuna Manganiferous Ores

Asked about his work, Mr. Joseph, referring particularly to the manganiferous ores of the Cuyuna range, where the reserves of such ores are the greatest in the United States, says:

"Due to the importance of manganese in the steel industry and the inadequacy of domestic reserves of ferro-grade ores, the problem of developing a method whereby the manganiferous ores of the Cuyuna range can be utilized in the production of an 80 per cent alloy is one of outstanding national importance. The Cleveland meeting of the A.I.M.E., held last April, and devoted exclusively to manganese, may be cited as evidence to support the contention that general interest in manganese has been greater in 1927 than at any time since the years of the world war.

"The North Central Station of the U. S. Bureau of Mines, in co-operation with the Minnesota School of Mines Experiment Station, obtained encouraging results during the year on a pyrometallurgical method for obtaining manganese from a brown type of manganiferous iron ores found on the Cuyuna. The particular phase of the problem under investigation involved treating, in a miniature open-hearth furnace, metal made the year before in a six ton experimental blast furnace. The results obtained in that blast furnace have been described in Bulletin 126 of the Minnesota School of Mines Experiment Station. The ore used contained about 8 per cent manganese and 34 per cent iron, natural basis. On an average, the metal produced in the blast furnace, and now being treated in the open-hearth, contains 12 per cent Mn, 4.5 per cent C, 0.24 per cent Si and 0.55 per cent P. To treat this metal it was necessary to design, build, and operate a miniature open-hearth, which was described in a paper presented before the Cleveland meeting last April.

"For a time no refractory lining for the open-hearth could be obtained which would withstand the corrosive action of a slag containing 60 per cent of manganous oxide. This difficulty has been overcome with water-cooled, sloping side walls lined with chrome brick, and a fortunate development has been the method of treating phosphorus. Although the phosphorus in the slag builds up to prohibitive concentrations, it has been found possible to reduce it, as well as the iron, to desired limits by providing a reducing atmosphere over the slag prior to tapping.

"The outstanding difficulty on which interest is centered at present is to produce a slag composed of basic oxides, largely iron and manganese, which will be sufficiently fluid to permit rapid diffusion of FeO from the slag to the metal, thereby allowing oxidation of manganese in the metal by oxygen supplied to the slag bath in the form of ore. It has been possible to obtain slags containing as much as 65 per cent MnO and appropriate amounts of iron and phosphorus, but the addition of acids to the slag has been necessary in order to work the heats in a reasonable length of time. The slag constituents comprise a new series of basic oxides upon which there is scanty information.

"You ask the precise objective of this investigation. It is to produce a slag containing about 60 per cent MnO, 10 per cent FeO, and 0.15 per cent P, with a minimum of acid constituents such as silica and alumina. This slag can be used readily in the production of commercial ferromanganese.

"While the problem is by no means solved, difficulties have been recognized, frankly admitted, and helpful suggestions have been obtained from many sources.

"In connection with the general problem of deriving manganese from domestic ores, some interesting sintering tests were made on samples of rhodochrosite from Montana. Due to geographical location of these orebodies with respect to steel centers, the importance of removing carbon dioxide at the mine is obvious. Preliminary tests show that it is an easy matter to expel carbon dioxide, the major difficulty being to secure a calcined product of suitable structure for blast-furnace use. Tests made by the Bureau indicate that CO_2 can be expelled during sintering, and that the structure of the sintered product is desirable for the blast furnace. Its chemical composition depends on the composition of the uncalcined ore."

Some Ores High in Sulphur

In discussing with President Hotchkiss the work of the Michigan Institute of Technology it was remarked that some of the iron orebodies of the state, otherwise satisfactory, contain sulphur in deleterious proportion, and he was asked if he had found a basis for fundamental investigation of this subject.

"The study of the sulphur situation was started a year ago in co-operation with mining companies," said President Hotchkiss. "In this work we have been developing methods of determining, in a quantitative way, the mineral form in which the sulphur is present in the ore. It was known that the sulphur was present as gypsum, pyrite, and barite, but a satisfactory method of determining the quantities present in each case was not available. This work has been carried on in co-operation with the University of Michigan and the State Geological Survey. Many tests have been made to find some cheap suitable leach that would eliminate sulphur. This work is still in progress."

"You were planning research in connection with iron ore beneficiation, so as to avert a decline in the industry when available commercial ores in Michigan approach exhaustion. How is this progressing?"

"In co-operation with the State Geological Survey we have started a study to find out the richness of the various members of the iron formation and the readiness with which the iron and silica can be separated. It is known well enough that some portions of the formation are intimately mixed iron oxide and silica, but no attempt has been made by any public body to determine quantitatively the amounts of these various phases of the iron formation. The Geological Survey had a party in the Iron River and Crystal Falls district this past summer doing field work on this subject. Many samples have been sent to the college laboratories, and work on these is in progress."

"You are securing data, therefore, on which to base the relative importance of different methods of beneficiation."

"Yes; it was felt that in this iron work the most important thing at the start was to get some fundamental, quantitative scientific data, and the work is planned to secure information of this sort in the first years of operation. When we have this data we will be prepared to go ahead with the study of possible methods of concentration."

"It is reported that you are studying comparative electrical conductivity of materials comprising portions of the lithosphere, and are working out new methods in this important and almost uncharted field."

"We are carrying on a line of investigation that is geophysical in character. In co-operation with the Terrestrial Magnetism Laboratory of the Carnegie Institution at Washington, we have been making in the vicinity of Houghton a large number of experiments to detect differences in character of the materials beneath the surface. We have found that by relatively simple and cheap measurements of the electrical resistivity we can measure the thickness of glacial drift and the depth to water level in the drift, and can distinguish in some cases rocks of different character lying beneath this glacial drift.

"Also, we have measured the characteristic resistivity of some of the various kinds of rocks about Houghton; we have found, for instance, that the copper-bearing series of traps vary from 100,000 down to 300,000 ohms per cubic centimeter, and the sandstones vary from 10,000 to 20,000. We are now equipping ourselves with apparatus to be used in continuing this work next season. This is an entirely new method of geophysical operation in the Lake Superior country, so far as I am informed, and much work must be done before we know the characteristics of the various kinds of rock formations under the differing circumstances in which they are found in the earth. We are carrying on experiments in the college laboratories on a variety of subjects related to these various lines of activity."

Ore Dressing Developments

Professor Davis, asked as to the work of the year at the mines experiment station of the University of Minnesota, said that this work can be divided into two main classes: "First, the removal of silica from iron ores by ore dressing methods; and second, the reduction of iron ore by sponge iron or metallizing processes." Continuing, Professor Davis said further:

"The progress made in silica elimination from iron ore was along two lines: First, crushing followed by washing; and, second, by the use of jigs. A few years ago, blast furnace operators objected strenuously to fine ore—that is, ore that did not contain coarse lumps perhaps 6 or 8 in. in diameter. Recently there has been a tendency to accept ore that has been crushed. This tendency has made possible considerable improvement in the washing of iron ore, due to the fact that the crushing of the ore usually breaks down the silica more rapidly than it does the iron oxide. The result is that each time the ore is crushed a concentrate of lower silica content can be made in the washing plant.

"During the past year some furnace operators have been willing to accept ore that has been crushed to pass a half-inch screen, provided the fine silica is washed away. The difference in grade of concentrate between washing a crude ore without crushing and washing the same ore after crushing to minus half inch often is remarkable, sometimes reducing the silica 4 or 5 per cent. The acceptance by furnace operators of ore crushed as fine as half inch will eventually make possible the utilization of a large amount of material that has been considered too low grade to wash."

"There are in Minnesota some 39 plants—not all under separate roofs—for the benefication of iron ore, and a third or more of the total shipments from the state is of ore treated in some manner. What seems to you to be the newest development in ore dressing, aside from what you have mentioned?"

"Much interest exists on the iron ranges as to the possibility of jigging lean ores. Many samples have been submitted to the experiment station for jigging tests, but, unfortunately, in most cases, very mediocre results have been secured. The existence of porous iron oxide and porous silica in many of the samples accounts for this inability to make good separation. A few samples of good jigging ore have been received, however, and undoubtedly jigs will be used to some considerable extent in the future.

"Our work on the direct reduction and metallizing processes has been progressing slowly, but with indications that eventually it will be possible to produce iron and steel without coke in competition with blast and open-hearth furnaces. All of the work at the experiment station so far has been of a technical nature, and it is not possible yet to assemble cost figures to demonstrate the economic value of this process. Considerable progress has been made in the chemical and metallurgical phases of the work, and, unless unforeseen difficulties arise, one of the many direct-reduction, or sponge-iron, processes will come into use eventually in quite a large way. Methods for eliminating phosphorus and sulphur from the reduced ore have been pretty well worked out, and, if efficient mechanical equipment and furnaces can be designed, it may be possible to produce a considerable tonnage of iron and steel at the mines in competition with existing furnace plants."

"Does this mean the actual production of iron in Minnesota on a large scale?"

"We have made considerable progress in this direction and believe that some direct reduction or metallizing process will eventually react to the distinct advantage of the mining industry in Minnesota."

Philadelphia Engineers' Club Celebrates Anniversary

LAST WEEK in Philadelphia makers of engineering history reviewed the progress of 50 years, interpreted the present, and attempted to unveil the future in a series of brilliant gatherings marking the golden anniversary of the Philadelphia Engineers' Club. Leading engineers from all parts of the country gathered as the guests of the club to hear the addresses and to celebrate the event in an atmosphere of good fellowship and of admiration for one of America's most successful engineering organizations.

Engineering of the past was pictured at the first session, held Friday evening, Dec. 16, by Willard Chevalier, general manager of *Engineering News-Record* and of *Construction Methods*, and Ambrose Swasey, past president of the American Society of Mechanical Engineers. These addresses were followed by a buffet supper, entertainment, and smoker.

On Saturday morning Josiah Penniman, Provost of the University of Pennsylvania, conferred the honorary LL.D. degree upon Howard Elliott, chairman of the board, Northern Pacific Railway; John Hays Hammond, mining engineer and past president of the American Institute of Mining Engineers; and Charles M. Schwab, industrial leader and president of the American Iron and Steel Institute.

Speaking at the luncheon on Saturday, Doctors Schwab, Elliott, and Frank B. Jewett, vice-president of the American Telephone & Telegraph Company, appraised the engineering achievements of today. In the evening, at a formal dinner attended by four hundred members and guests, J. H. M. Andrews, president of the club, conferred honorary life membership on Charles Billin, who was a prime mover in organizing the club and who has been its secretary throughout its half century of existence. This was followed by two brilliant addresses in which Dr. Samuel Rea, honorary member of the club and past president of the Pennsylvania Railroad, and Dean Dexter S. Kimball of Cornell University extrapolated present trends to sketch an engineering picture of 1977.

California Dredge Operators Meet at Sacramento

On Dec. 9, the California Gold Dredge Operators, a division of the California Mineral and Metal Producers' Association, held a meeting at Sacramento, Calif., as guests of John A. Roebling's Sons Company, American Manganese Steel Company, Columbia Steel Company, Taylor Wharton Company, American Rubber Manufacturing Company, and the Pacific Gas & Electric Company. About 50 attended the meeting, which was presided over by Charles W. Gardner. The future of the industry was the chief topic discussed.

Book Review

The New Peele

MINING ENGINEERS' HANDBOOK. Robert Peele, editor-in-chief. Second edition. John Wiley and Sons, New York, pages 2523; 4½x7. One volume edition, flexible (and strongly bound) $10. Two volume edition, leather, $12.

THE new "Peele" is up to date. In the years that have elapsed since the appearance of the first edition, some remarkable developments have taken place in various branches of mining engineering, notably in the application of geophysical science to the search for ore and in mechanical mucking and loading. Moreover, in this period costs have risen greatly; electricity has been steadily replacing steam for power purposes; hammer drills have supplanted reciprocating machines to a great extent; and improvements have been numerous and marked in practically all equipment used for mining purposes. The need for a new edition of the Handbook had, therefore, become imperative. In meeting it so well, Professor Peele has scored a new achievement. The new volume is worth acquiring, if only for the new data it contains.

A critical review of the five-foot shelf of books compressed within the Handbook's covers is obviously impossible, but the reviewer can perform a useful service by sketching briefly for the reader the outstanding changes. The preface states that many subjects have been almost entirely rewritten, notably 12 of the 44 sections, and that 13 others have been greatly altered and the balance revised when necessary.

Proceeding orderly through the volume, it is not until we reach Sec. 10, on "Prospecting, Development, and Exploration of Mineral Deposits," that the revision made is striking. Section 10, as revised, now covers 568 pages against 448 pages in the original. To the five pages on magnetic surveying, five more on other geophysical methods of surveying have been added, the latter from the pen of Dr. L. B. Slichter. The eye is then caught by an item, obviously new, on the Quebec copper-gold belt, and, next, by interesting new tables of development data.

What is the record for drifting and crosscutting? The question can scarcely be answered because of the variables involved. But in these tables are listed the significant data of 106 drifting and cross-cutting jobs, with an attempt at a summary of the results according to the nature of the ground; similarly 57 cases of raises and winzes are recorded. From these tables the inquirer as to records may make his own selection.

The revision of the text on metal mining methods and costs has been helped materially by the data collected by the A.I.M.E. two years ago. The topics newly covered in the added matter include the following: Recovery of caved stopes; the application of shrinkage stoping to large deposits, illustrated by specific cases; examples of top slicing; and numerous instances of scraper, or slushing, practice. Extraction results in block caving and the factors affecting extraction are given; likewise data on leaching copper ore in place—and we are only two-thirds through the section.

Continuing, we find a reflection of the development of underground mechanical loading in the quadrupling of the space devoted to "Handling Ore in Flat Stopes," this in order that machine loading may be covered properly. Further, the pages on ground movement and subsidence have been rewritten, as one would expect in view of the recent studies of the subject. The article on placer mining is little changed save for the introduction of up-to-date cost data, and of a short exposition of cold water thawing, as well as of a detailed description of the method of working alluvial tin deposits in the Malay States. This brings us to the end of a most ambitious section.

THE EQUIPMENT SECTIONS

Design of mine cars has gone through needed improvements in the last decade, a fact that is taken into account in the section on underground transport, following. Bearings—ball and roller—for wheels are discussed at greater length, and a few paragraphs on car dumps are added. Less space is properly given to haulage with endless ropes.

Anaconda's air hoists, the leading examples of this type, although they are now being rapidly electrified, are shown in the section on hoisting plant and ore bins. Here the principal changes are in the expansion of the part on skips. Room for a description of Lilley hoist control has been made in the pages on overwinding, also for a description of suspension mill bins in the latter part of the section.

The Cornish pump has passed—all reference to it is omitted. The trend toward electric pumping with its opportunities for automatic control and the steady decrease in the number of steam units in use, has compelled the modernizing of the pumping section. As for mine ventilation by mechanical means, this is no longer so largely a task for the coal mining engineer alone, and all of six pages are devoted to the topic in its specific relation to metal mines. An exposition of the theory of impulse fans is added. The Wahlen gage and other control devices are given due attention. Further along in the book, it might be added, the matters of conditioning and refrigerating mine air are duly treated.

Compressed air receives much the same attention as in the earlier work. More space indeed is given to the subject of the air lift. It is in the part on rock drills that the principal revision of this section has taken place. Brief mention only is made of reciprocating drills, which formerly predominated, and hammer drills are discussed in detail in their place. A short treatise on working in compressed air is added.

Surveying, the topic of Sec. 17, is an art which might be considered static. Nevertheless, some revision has been required and two pages on aerial surveying have been added. A further valuable addition is the six page description of the procedure followed in surveying mineral lands, with the forms of the certificates required.

The section on the cost of mining is more compact in the new edition and tables of up-to-date costs of various mining companies have been included. Much new and useful information is given in the section on Mining Laws which follows. This includes summaries of the Federal tax laws which relate to mines and of the mining laws of Mexico and Canada. The last is quite important in view of the current interest in mining in Quebec, Ontario and Manitoba. Two paragraphs on "Valuation for Tax Depletion" have been inserted in Sec. 25, on "Mine Examinations, Valuations, and Reports."

Tramways, cableways and conveyors are treated in succeeding sections. The more complicated problems of tramway design are dealt with in four new pages. Some space is given to a discussion of storage piles.

In place of the 106 pages on "Ore Dressing," by the late R. H. Richards, is a 24-page section by Prof. A. F. Taggart on "Breaking, Crushing and Sorting of Ore." The preface explains that now that a modern work on ore dressing is available (Taggart's "Handbook of Ore Dressing"), no reason exists for retaining the subject in this already overcrowded volume. Prof. Taggart has also rewritten the section on "Testing of Ores" (formerly by J. E. Clennell and E. K. Judd), though retaining the original text on "Amalgamation and Cyanidation."

In the twelve remaining sections of the Handbook, few changes are readily detectable, save in Sec. 30 on "Gold Amalgamation and Cyanidation." In place of the late E. L. Dufourcq, this section has been revised by J. V. N. Dorr, who has used much better flow sheets; also cost data that are up-to-date.

A WEALTH OF FACT

A journey, page by page, through the 2,500 pages of this volume, such as the foregoing has necessitated, impresses the reviewer, as never before, with the wealth of data here assembled. Truly a great service has been performed by Prof. Peele and his collaborators. Facts, theory and illustration—all are much compressed, and careful reading by the engineer or student is necessary, if the full value of the mass of material is to be extracted.

It was in 1922 that the Mining and Metallurgical Society awarded its gold medal to Professor Peele for "distinguished contributions to the literature of mining engineering," an award that was based principally on the "Mining Engineers' Handbook." If the earlier work was good, the revised edition is better, sufficiently better to warrant the "scrapping" of the old and its replacement by the new. It is one of the working tools of the mining engineer —or should be. A. H. HUBBELL.

Personal Notes

GEORGE KINGDON, of Jerome, Ariz., has returned from a visit to the new mining districts of Ontario, Canada.

ROBERT JOWSEY has been engaged to superintend the operations at the Sheritt-Gordon copper property at Cold Lake, in northern Manitoba.

P. M. ANDERSON has been elected a director of the Union Corporation, Ltd. He will continue to act as Johannesburg manager of the corporation.

R. E. CRANSTON, general manager of the South American Gold & Platinum Company, sailed on Dec. 21 on a trip of inspection through the Choco district of Colombia, South America.

MAJOR A. J. PELLING, of the Rand University Chemistry Department, is on holiday leave in South West Africa and reports large deposits of valuable guano in the caves around Karibib.

C. P. MCCORMACK, consulting mining engineer with Crowell & Murray, Inc., of Cleveland, Ohio, is sailing on Dec. 24 for Russia as consultant on the rehabilitation of Russian iron ore mines.

R. S. BAVERSTOCK, of Baverstock & Payne, Los Angeles, who returned recently from the Gold Springs Mining district of Nevada, is away examining mining properties near Merced, Calif.

B. V. LOMBARD, of the Transvaal University College, has been appointed junior geologist on the staff of the Director of the Geological Survey, to fill the vacancy caused by the retirement of Dr. P. A. WAGNER.

FRED WARTENWEILER, assistant consulting metallurgist to the Rand Mines, Ltd. (who was one of 30 South African representatives at the recent metallurgical congress at Toronto), arrived at Johannesburg on Nov. 1.

R. K. STOCKWELL, British engineering manager for the Robins Conveying Belt Company, will spend Christmas and most of January in America, his address being at the New York headquarters of that company.

HAL M. LEWERS, formerly chief metallurgist for the Tonopah Belmont Development Company at Tonopah, Nev., now mill superintendent for the same company at its Wickenburg (Ariz.) property, has returned to Wickenburg after a week's visit in Tonopah.

OTTO ELLERMAN, of Lead, S. D., who has been State Mine Inspector of South Dakota for the past fourteen years, and HARRY T. CURRAN, mining engineer and geologist and for five years manager of the Carissa Mine at South Pass, Wyo., are now connected with the R. A. Perez Company, of Los Angeles.

C. W. NICHOLS, president of Nichols Copper Company, recently returned from a European tour including France, Belgium, Germany, and England, Mr. Nichols says that the metal industry abroad is in a healthy condition, especially in Germany. While in Belgium he visited the new copper refinery constructed for Union Minère du Haut-Katanga at Oolen.

JOHN S. CRAWHALL, of the technical staff of François Cementation Company, Ltd., Doncaster, England, has arrived in the United States. The process developed by his company—involving grouting with cement and other special additives under high pressure, for

JOHN S. CRAWHALL

the solution of stubborn problems caused by abnormal water flow in mines, and for other purposes—has been commented upon in the technical press from time to time, but has attracted little attention on this side of the Atlantic. Mr. Crawhall now reports that the several advantages of such high-pressure grouting, as applied by cementation specialists in the South African mines with conspicuous success, and for the stabilization of the piers of St. Paul's Cathedral and the foundations of other notable buildings, are being recognized in this country, and it is probable that a subsidiary company will be formed in the United States to attend to the extensive demand being made for the services of his company and its engineers in the Americas.

WILMOT L. MATTHEWS, of Toronto, has been elected vice-president of the Consolidated Mining and Smelting Company of Canada, in succession to the late C. R. Hosmer, of Montreal. He is head of the firm of W. D. Matthews & Company, grain and malt dealers and exporters, and identified with several industrial and financial corporations, including the Canadian General Electric Company, of which he is a director.

L. K. JACOBSEN, who has been metallurgist for the Utah-Apex Mining Company for a number of years, and to whom much of the credit is due for the successful selective flotation of lead-copper ore, has been retained to go to Mount Isa, in Queensland, for the Russo-Asiatic interests, which have taken over the Mount Isa lead-silver properties. He will develop a metallurgical treatment for the ore.

W. L. HEIDENREICH, mining engineer, representing important New York interests, has returned from an examination of the Gordon Murray lead-zinc claims, located in northern Manitoba. Mr. Heidenreich was previously engaged for some time in directing work on the Sherritt Gordon copper property at Cold Lake, Manitoba, and will soon leave for Alaska to look over properties there.

LIONEL C. BALL, deputy chief of the geological survey of Queensland, Australia, and state petroleum geologist, has lately been appointed a member of the oil advisory board created a short time ago by the Queensland Government. He will probably leave Brisbane about the middle of December for the United States, where he will investigate problems that have presented themselves in connection with the recent discovery of oil at Roma, Queensland.

D. H. FERRY has just completed an extensive drilling campaign that he has been conducting on the Foot's Creek property, near Rogue River, in Oregon. Mr. Ferry has had two drilling crews at work there for the last six months. This work is being done in connection with the Ludlum Engineering Corporation, and it has been decided to equip the property with an 8-cu.ft. electrically driven dredge. It is expected that this dredge will be ready for operation early next summer.

OBITUARY

Major AUGUSTUS HEISE, former Assistant Prohibition Administrator, died recently in Brooklyn. He was a former mining engineer.

JERONIMO CALERA, of Cananea, Sonora, Mexico, died in that camp on Dec. 6. Together with the late Colonel William Green, Mr. Calera shared the honor of being one of the founders of Cananea. Mr. Calera leaves a widow.

Count RÉNE DE SALLIER DU PIN died suddenly in Paris on Dec. 13. M. du Pin was born at Watertown, N. Y. He was graduated from the School of Mines, Columbia University, in 1905. The earlier years of his professional life were passed in Montana and Mexico, where he supervised the construction of the first process for the flotation of copper. Later he went to Paris and was associated for seven years with the Société Franco-Americaine de Metaux, Paris. In 1926 he was appointed American representative of the copper producers on the Brussels Committee of Copper Exporters, Inc. He assisted in the organization of the Copper and Brass Research Association of Belgium and France and he was its manager at the time of his death.

Market and Financial News

Burma Corporation Reports Lower Earnings for Last Fiscal Year

BURMA CORPORATION, LTD., which operates the well-known Bawdwin lead-zinc-silver mines, in Upper Burma, increased its production of lead by 10.8 per cent; decreased silver output by 2.5 per cent; and realized a considerably smaller profit on its operations for the fiscal year ended June 30, 1927, than for the preceding year. The comparative figures are shown in the accompanying summary:

	1926	1927
Ore mined, tons	356,222	411,886
Lead produced, tons	51,270	56,791
Silver produced, oz	5,216,102	5,088,042
Working profit	£1,361,357	£1,153,322
Net profit	948,668	775,707

Although 411,886 tons of ore was mined during the year, the reserves decreased only 25,961 tons, to 4,114,610 tons, having an average content of 22.4 oz. silver, 26.2 per cent lead, and 16.6 per cent zinc. This is slightly higher as to silver content than the figure for the reserves as estimated one year before.

The average grade of the ore mined in the period under review was lowered because of the suspension of operations in the fire area for a time. However, working conditions are now near normal, and richer ore is being mined. The main circular shaft was sunk an additional 63 ft., to 1,002 ft., during the year and the masonry and steel work have been completed to this depth.

Daily tonnage of ore extracted was 1,128, against 976. The total number of shifts worked at the mine in all departments was 1,666,484, or a total of 4.04 shifts per ton of ore. This compares with 3.975 in the preceding year. Ore sent to the concentrator totaled 322,597 tons, from which was produced the products shown below:

	Tons	Lead, per Cent	Silver, oz. per Ton	Zinc, per Cent
Ore concentrated	322,597	20.92	18.16	13.43
Lead "products"	111,686	50.49	41.31	13.75
Zinc concentrate	44,568	7.14	13.06	46.45
Tailings	157,795	3.05	2.07	3.09

Besides shipping 109,594 tons of material to the smelter, the mill forwarded 54,287 tons of zinc concentrate to Europe for smelting. Increased tonnage handled and improved results are reported for the smelter. The following statistics summarize the work done:

	Tons
"New" lead products smelted	131,378
Secondary lead products	85,858
Copper ore and matte	55,494
Iron ore	41,994
Other fluxes	24,328
Hard lead produced	68,620
High-grade copper matte	12,141
Antimonial lead	973
Coke used	46,162

Europe Takes Bulk of Chilean Copper

Production of copper in Chile during the third quarter of 1927 was slightly less than in the preceding quarter, according to a report to the U. S. Department of Commerce. Europe, especially Germany and France, continued to place large orders, buying more than the United States. Exports amounted to 30,782 metric tons (16,305 to Europe and 14,477 to the United States), compared with 36,074 tons in the second quarter and 27,791 tons in the first.

Production at Chuquicamata was somewhat less than in previous quarters, due chiefly to world market conditions and the price of copper.

AHUMADA LEAD COMPANY, operating in northern Chihuahua, during the nine months ended Sept. 30 produced 42,614 tons of ore, from which the smelter returned 20,919,645 lb. of lead. Gross receipts during the period were $1,585,904, compared with $2,484,851 in the corresponding period of the year 1926. Net income declined from $827,617 to $149,002 for the nine months; and for the third quarter the decline was from $230,094 to $20,792.

SANTA GERTRUDIS COMPANY, LTD., the principal operations of which are at Pachuca and Fresnillo, Mexico, reports a profit for the year ended June 30, 1927, amounting to £266,482, almost entirely the result of silver and gold production at Pachuca. A total of 758,052 metric tons of ore was cyanided, with production of 10,022,460 oz. of silver and 41,877 oz. of gold. Ore reserves are estimated as 1,323,000 tons, with a gross recoverable content of 78,000 oz. of gold and 18,516,000 oz. silver. Lower prices for silver, and for lead and zinc with respect to the sulphide ores, adversely affected results at the Fresnillo unit. During the third quarter of 1927 the Pachuca mill handled 173,125 tons of ore, giving a net return, before deducting depletion and depreciation, of $464,310.

SOUTH AMERICAN GOLD & PLATINUM COMPANY, dredging in Colombia, South America, according to the report of the Consolidated Gold Fields of South Africa, realized a profit of $581,869 from the production of 18,923 oz. of platinum during 1926. The average price of crude platinum during the year was about $107, compared with about $60 at present.

STATISTICAL NOTES

COPPER PRODUCTION for November, according to the A.B. of M.S., was at the rate of 4,730 tons a day, compared with 4,680 in October. This is based on reports from countries producing about 98 per cent of the world total. November showed the largest figure reached since last February. Mexico, Chile, and the Belgian Congo showed increases. Production from the United States was a little higher in total tons, but the daily rate was definitely lower than in the preceding month.

SILVER PRODUCTION in September, the latest month for which world statistics are available, was at the rate of only 597,000 oz. a day, compared to 649,000 oz. in August. This rate is lower than that of any of the three preceding months. Data for November show increases in the production rates of United States, Canada, and Peru, compared with the figures for October.

HECLA MINING COMPANY, operating in the Coeur d'Alene district in Idaho, produced less lead and realized materially less profit in the third quarter of 1927 than in the same period of 1926. The comparative figures follow:

	1927	1926
Tons mined	70,419	87,580
Lead produced, lb.	12,758,474	13,866,013
Average lead price, cents	6.42	8.69
Silver produced oz.	375,071	377,510
Average silver price, cents	$0.55	$0.59
Gross income	$750,292	$1,077,087
Operating expenses	374,970	430,218
Taxes accrued	62,500	72,495
Depreciation	61,800	77,537
Net profit	$251,022	$496,838

GOLD MINING on the Witwatersrand was more profitable during the year ending June 30, 1927, than in the preceding year, as will be seen from the following comparative statistics, showing an increase in working profits of £403,615:

	Year Ended June 30 1926	1927
Tons milled	28,808,258	29,458,905
Yield in ounces	9,342,495	9,675,829
Total revenue declared	£39,851,521	£41,238,353
Working expenditure	£27,308,562	£28,291,779
Profit on working	£12,542,959	£12,946,574
	—Per Ton Milled—	
Revenue	27s. 8d.	27s. 11d.
Working costs	19s. 0d.	19s. 2d.
Working profit	8s. 8d.	8s. 9d.

FEDERAL MINING & SMELTING COMPANY, operating in Idaho and Oklahoma, reports for quarter ended Oct. 31, 1927, net earnings of $597,615 before charges for construction, equipment, depreciation, depletion, and taxes. This compares with $679,097, including $139,740 dividends on company's stock purchased in the preceding quarter, and net of $1,064,342 in corresponding quarter of 1926. In the quarter the company shipped 40,291 short tons of concentrate, compared with 36,205 tons in preceding three months. The highest price obtained for lead during the three months was 6.80c. and lowest 6.25c. a pound: for zinc the range was 6.45c. and 5.80c., and for silver 56⅜c. an ounce and 54⅛c.

The Market Report

Metal Prices Ease Slightly in Dull Holiday Market

New York, Dec. 21, 1927—Prices for all of the major non-ferrous metals, New York lead only excepted, are a little lower than they were a week ago. The declines, however, are very small and are not particularly significant, because of the fact that all of the markets have been exceedingly dull and slight concessions were made in some instances to effect sales. Sentiment is generally good, and sellers are content to wait until after the first of the year, when resumption of buying on a "normal" scale is anticipated.

Daily Prices of Metals

ec.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
15	13.775@13.925	58.125	58.625	6.50@6.55	6.30	5.65@5.70
16	13.775	58.125	58.50	6.50	6.30	5.65@5.70
17	13.65	58.125	58.50	6.50	6.30	5.65@5.70
19	13.525@13.675	57.625	58.125	6.50	6.30	5.65
20	13.675	57.625	58.00	6.50	6.30	5.65
21	13.65	58.00	58.375	6.50	6.30	5.625@5.65
	13.700	57.938	58.354	6.504	6.300	5.660

Average prices for calendar week ending Dec. 17, 1927, are: Copper, 13.792; 99 per cent tin, 58.104; Straits, 58.563; N. Y. lead, 6.508; St. Louis lead, 6.310; zinc, 5.704; and silver, 58.271.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary form of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.13c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
15	59 3/4	59 15/16	66 1/4	267 1/2	263 1/4	22 1/8	22 7/16	26 5/16	26 1/8
16	59 9/16	59 13/16	66 3/8	267 3/8	263 3/8	22	22 5/16	26 3/16	26
19	59 5/16	59 9/16	66 1/4	265	262	21 7/8	22 3/16	26 1/4	26
20	59 9/16	59 3/4	66 1/4	264 1/4	261 3/4	21 13/16	22 1/8	26 5/16	26
21	59 3/4	59 15/16	66 1/4	266 1/2	263 1/8	21 13/16	22 1/8	26 3/16	25 15/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
15	4.87 7/8	58 1/8	26 3/4	84s11 1/2d	19	4.87 7/8	58 1/8	26 11/16	84s11 1/2d
16	4.87 11/16	58 3/8	26 13/16	84s11 1/2d	20	4.87 3/4	57 3/4	26 7/16	84s10d
17	4.87 9/16	58 1/4	26 13/16	.....	21	4.87 13/16	57 1/2	26 3/8	84s10d
					Avg.		57.979		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Copper Largely Nominal at 13.875c.

Last Thursday several good sales of copper were made at prices ranging from 14c. in Connecticut, to 14.25c. at high freight-rate destinations. Since then the large producers have been quoting 14c. (some even 14.125c.), at which figure only scattering sales have been made, with the exception of one large order placed at 14c. for delivery in the so-called Middle West area. Sellers who felt obliged to dispose of some metal cut the price to 13.875c. on Saturday and on Monday sold at prices ranging as low as 13.75c. Apparently these sales eased the pressure, and yesterday and today no metal has been obtainable at prices under 13.875c. and several small parcels brought even more. Despite the sag, the tone of the market seems good, and with the statistical position not unfavorable, producers are looking forward with confidence to the new year. The foreign price of Copper Exporters has been maintained all week at 14.50c. c.i.f., and, though by no means brisk, business has been fair. Just as in the domestic market, a lull is to be expected after the extremely active buying movement that extended over many weeks prior to the slowing up that took place early in December. Sales in the f.a.s. market have been made at 14.20c.

Lead Quiet and Unchanged

The situation in the lead market has not changed during the last week. The American Smelting & Refining Company continues to quote its contract price at 6½c., New York, and this price basis has been realized on most of the business done in the East. In the Middle West, one of the principal producers continues practically out of the market, quoting 6.35c., St. Louis, but selling only an occasional carload at that level. Others have sold small amounts at 6.325c., but the bulk of the business has gone at 6.30c., St. Louis, at which level lead could be obtained for deliveries all the way from prompt to February.

Sales in the week ending today have been well below normal, and but little improvement is expected till after the holidays.

Contracts for the coming year have been coming in very satisfactorily, with the indications that 1928 requirements will be above those for the year just ending; increased premiums over base prices have in some instances also been secured. Cable manufacturers, particularly, seem to be hopeful over prospects. Producers, although they do not expect a booming lead market in the first half of the year, hope for a slight advance in prices.

Little Change in Zinc

A fair quantity of zinc was sold during the week at 5.65c. to 5.70c., the former figure applying to the greater tonnage. Galvanizers have been the principal buyers, picking up metal which

they think is reasonably cheap. Today 5.625c. is bid and 5.65c. is asked, with neither buyers nor sellers particularly anxious to do business. High-Grade is still quoted 7.75c. New York for spot lots, but the quotation is nominal.

Tin Slightly Above 58c.

The tin market has also been quiet, though a few small sales have been made to consumers each day, chiefly for forward delivery, which commands the same prices as prompt. The variation in price during the week has been small—between 58⅝ and 58c.

Silver Quiet and Lower

The silver market during the last week has been quiet, with a downward tendency. Reports from abroad state that India has been a moderate buyer. China sold against operations in yen. The market closes dull and uncertain.

Mexican Dollars (Old Mexican pesos): Dec. 15th, 44¾c.; 16th, 45c.; 17th, 44⅞c.; 19th, 44¾c.; 20th, 44⅜c.; 21st, 43⅞c.

Exchanges Steady

No changes of importance have taken place in the quotations for the principal foreign exchanges. Closing cable quotations on Tuesday, Dec. 20, were: francs, 3.93¾c.; lire, 5.43c.; and marks, 23.905c. Canadian dollars, ⅛ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 98 or 99 per cent grade, price of leading interest, 25c.; outside market, 24.30@24.80c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, spot business, range for the week 11½@11¼c. Forward positions through February at same levels.

Cookson's "C" grade, spot, 16⅜c. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c.

BISMUTH—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

IRIDIUM—Per oz., $120@$130 for 98@99 per cent sponge and powder. Considerable activity. Strong market; shortage of supply.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $49@$51. Small lots bring up to $54.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Dealers and refiners quote the trade for refined metal, per oz., cash, $64@$65. Market moderately active.

QUICKSILVER—Per 76-lb. flask, range for week, $126@$127, depending on quantity. Market very quiet. Inventory taking has depressed domestic price below "replacement" cost in foreign market. San Francisco wires $129.50. London, £23; market firm.

RHODIUM—Per oz., $50@$55; London £8@£11½, nominal.

RUTHENIUM—Per oz., $40. Market strong.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Dec. 3.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn. c.i.f. North Atlantic ports, minimum 47 per cent Mn; 34@38c. Caucasian, washed, 53@55 per cent, 38.50@40c. Chemical grades unchanged from quotations in the Dec. 3 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.25@$10.50. Western scheelite, $10.50@$10.75. Market dull, but asking price higher.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the Dec. 3 issue.

Zinc Ore Lower in Joplin

Joplin, Mo., Dec., 17, 1927

Blende

High	$42.45
Premium blende, basis 60 per cent zinc	$38.00@39.00
Prime Western, basis 60 per cent zinc	36.00@37.00
Fines and slimes, 60 per cent zinc	33.00@36.00
Average settling price, all zinc	36.55

Galena

High	$86.80
Basis 80 per cent lead	85.00
Average settling price, all lead	86.55

Shipments for the week: Blende, 11,468; lead, 2,864 tons. Value all ores the week, $664,320.

The zinc ore market was again freakish, with the high basis price being bid early in the week. Sellers assert the price is being lowered by producers in an effort to reduce stocks in view of a $3 per ton school tax applicable to each ton of ore in the bins on Dec. 31.

Platteville, Wis., Dec. 17, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$39.75

Lead Ore

Lead, basis 80 per cent lead	$85.00

Shipments for the week: Blende, 1,102 tons; lead, none. Shipments for the year: Blende, 621,106; lead, 1,965 tons. Shipment for the week to separating plants, 2,409 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Dec. 3 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market slack. London, Cornish white, per long ton, £18¼.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the Dec. 3 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or c.i.f. port of entry, $100 quoted for first quarter, 1928. Spiegeleisen, 19@21 per cent, $30@$31 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 93@95c. f.o.b. works. Dull.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the Dec. 3 issue.

Metal Products

ROLLED COPPER—Sheets, 22¾c.; wire, 15¾@16c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled 10c. per lb.; clipped, 10¼c.

NICKEL SILVER—29¼c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¾c. per lb.; rods 16¾c. per lb.

ZINC SHEETS — 10c. per lb., f.o.b. works.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the Dec. 3 issue.

Steel Steady; Iron Off 25c.

Pittsburgh, Dec. 20, 1927

The rate of steel mill operation is well sustained, with prospects of little slowing down for the holidays, and a virtual certainty of increasing production for at least three months after Jan. 1. For four successive years March has shown practically the same rate of steel production, nearly one-third above the present rate, and next March is quite unlikely to prove an exception.

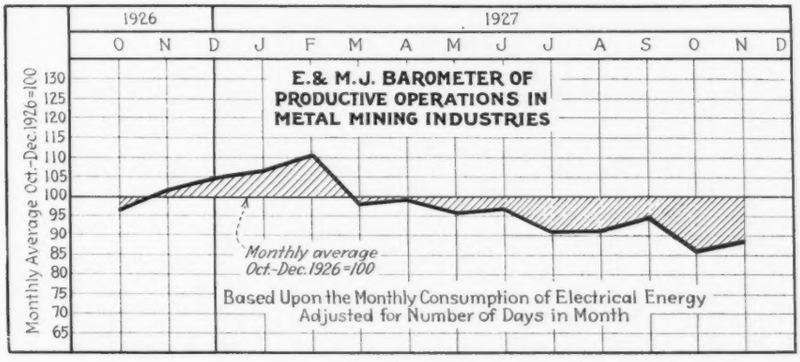
Bar, shapes, and plate prices are holding well at the recent advance, and another advance after Jan. 1 is expected. Sheet mills are advancing prices about $3 a ton, but buyers have opportunity to cover for first quarter at old prices.

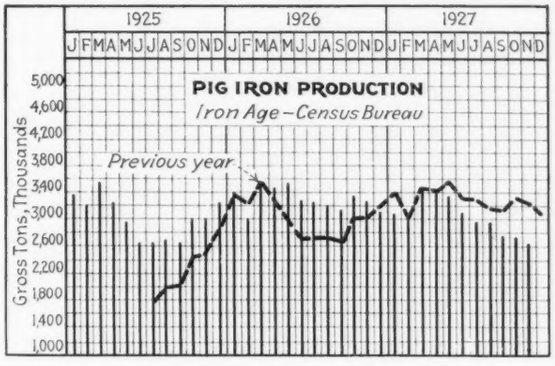
Pig Iron—Bessemer pig iron at Valley furnaces has slipped 25c. to $17.50. Foundry is slightly more active, at $17.25@$17.50. Basic remains nominal at $17.

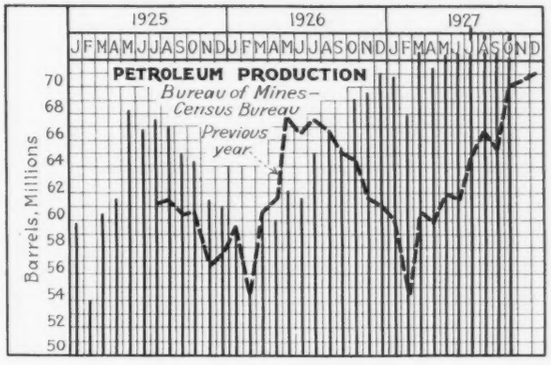
Connellsville Coke—Three furnace coke contracts for first quarter have been made at approximately $3. Spot furnace is firmer, at $2.75@$2.90, and foundry unchanged at $4@$4.75.

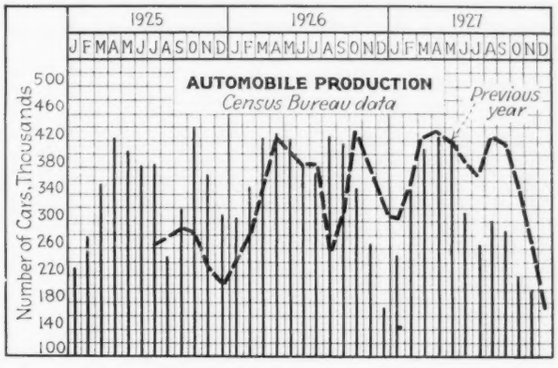
Indicators of Industrial Activity

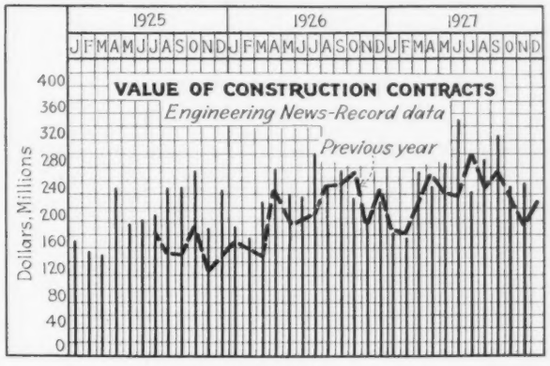
of Significance to Mining

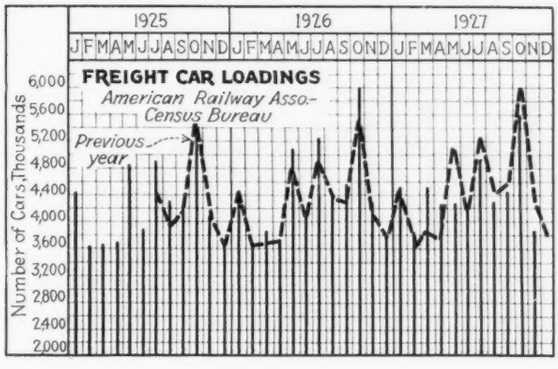

1926
1927
O N D J F M A M J J A S O N D
E.& M.J. BAROMETER OF PRODUCTIVE OPERATIONS IN METAL MINING INDUSTRIES
Monthly Average Oct.-Dec.1926=100
130 125 120 115 110 105 100 95 90 85 80 75 70 65
Monthly average Oct.-Dec.1926=100
Based Upon the Monthly Consumption of Electrical Energy Adjusted for Number of Days in Month


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PIG IRON PRODUCTION
Iron Age—Census Bureau
Previous year
Gross Tons, Thousands
5,000 4,600 4,200 3,800 3,400 3,000 2,600 2,200 1,800 1,400 1,000


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PETROLEUM PRODUCTION
Bureau of Mines—Census Bureau
Previous year
Barrels, Millions
70 68 66 64 62 60 58 56 54 52 50


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
AUTOMOBILE PRODUCTION
Census Bureau data
Previous year
Number of Cars, Thousands
500 460 420 380 340 300 260 220 180 140 100


1925
1926
1927
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
VALUE OF CONSTRUCTION CONTRACTS
Engineering News-Record data
Previous year
Dollars, Millions
400 360 320 280 240 200 160 120 80 40 0


1925
1926
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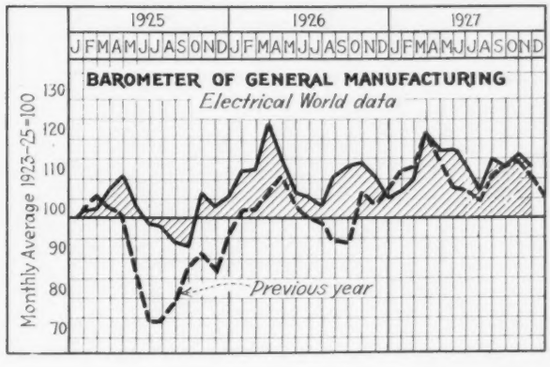
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
FREIGHT CAR LOADINGS
American Railway Asso.-Census Bureau
Previous year
Number of Cars, Thousands
6,000 5,600 5,200 4,800 4,400 4,000 3,600 3,200 2,800 2,400 2,000


1925
1926
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J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
BAROMETER OF GENERAL MANUFACTURING
Electrical World data
Previous year
Monthly Average 1923-25=100
130 120 110 100 90 80 70

Mining Stocks—Week Ended December 17, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	57	52⅛	57	Oc.15, No.21 Q	0.75
Arcadian Consol.	Boston	3	1⅛	2 3/16		
Ariz. Com'l	Boston	7	5⅛	6⅛	Jy. 18, Jy. 30	0.25
Calaveras	N. Y. Curb			1¼		
Calumet & Arizona	New York	110¾	97½	109¾	De. 3, De. 9 Q	1.50
Calumet & Hecla	Boston	24	18⅛	22⅛	No.30, De.15 Q	0.50
Cerro de Pasco	New York	67½	65	66⅜	Oc.13, No.1 Q	1.00
Chile Copper	New York	40⅞	37⅛	40⅜	De. 2, De. 30, Q	0.62½
Con. Coppermines	N. Y. Curb	6⅛	5	6⅛		
Copper Range	Boston	21½	16½	20⅛	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*39	*35	*36		
East Butte	Boston	2½	2	2½	Dec. 1919	0.50
Granby Consol.	New York	43½	40½	42½	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	133⅞	117	130½	Nov., 1920	0.50
Howe Sound	New York	44	42	44	Oc.1, Oc.15, Q	1.00
Inspiration Consol.	New York	21¾	19⅛	21⅝	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	3	2⅛	2⅛		
Isle Royale	Boston	15½	13	14½	Se. 30, Oc. 15, Q	0.50
Kennecott	New York	83¼	81½	83½	De. 2, Ja.3 Q	1.25
Magma Copper	New York	53	49½	52½	De.30, Ja.17 Q	0.75
Mason Valley	N. Y. Curb	1⅞	1½	1⅝		
Miami Copper	New York	19⅜	18⅜	19	No.1, No.15, Q	0.37½
Mohawk	Boston	52	48½	49⅞	Oc.31, De.1 Q	2.00
Mother Lode Coal	New York	3⅞	3½	3½	De.16, De.31	0.25
Nevada Consol.	New York	20⅜	19½	20⅛	De.16, De 31 Q	0.37½
New Cornelia	Boston	30	28	28⅜	No.4, No.21 Q	0.50
Noranda	N. Y. Curb	24⅜	22⅜	23⅜		
North Butte	Boston	1½	1	1¼	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1 1/16	*93	*99	Sept. 1926	0.03
Old Dominion	Boston	12¼	11½	12¼	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	127	125½	127	De.17, Ja.3 Q	1.50
Quincy	Boston	17	14	16¼	March, 1920	1.00
Ray Consolidated	New York	....	....	15½	Ap.20, Ap. 30	0.25
St. Mary's Min. Ld.	Boston	31	28	30½	Fe.10, Ma.10	2.00
Seneca Copper	New York	2¼	2	2¼		
Shattuck-Denn	Boston Curb	12⅝	11⅞	12		
Tenn. C. & C.	New York	11½	10⅜	11½	No.30, De.15, Q	0.12½
United Verde Ex.	N. Y. Curb	29⅞	28¼	28⅜	Oc.6, No.1 Q	0.75
Utah Copper	New York	...	...	1⅜	De.16, De.31 Q	1.50
Utah Metal & T.	Boston	1¼	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*53	*51	*52		
NICKEL-COPPER						
Internat. Nickel	New York	76⅜	71½	75¼	De.16, De.31 Q	0.50
Internat. Nickel pfd.	New York	...	...	108	Oc. 13, No. 1 Q	1.50
LEAD						
Gladstone Mtn.	Spokane	*15¼	*14	*14	June, 1927	0.005
National Lead	New York	133	125	130	De. 16, De. 31 Q	1.25
National Lead pfd.	New York	115	114	115	Ja.13, Fe. 1 Q	1.50⅝
St. Joseph Lead	New York	42	40	41⅛	De.10, De.20, QX	0.75
ZINC						
Am. Z. L. & S.	New York	8	7	7⅛	May, 1917	1.00
Am. Z. L. & S. pfd.	New York	44½	40½	42	Nov., 1920	1.50
Butte C. & Z.	New York	4½	4	4⅛	De. 9, De. 24	0.50
Butte & Superior	New York	11¼	9½	10	De.16, De.31 Q	0.50
Callahan Zn-Ld.	New York	1⅞	1⅜	1⅜	Dec., 1920	0.50
Consol.Lead&Zinc'A'	St. Louis	14	11⅛	14	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	24¾	23⅞	23⅞	No.15, De.1 Q	0.40
Eagle-Picher pfd.	Cincinnati			117½	Jn.30, Oc.15 Q	1.50
New Jersey Zn.	N. Y. Curb	187¾	180¼	185⅝	No. 19, De. 10 X	2.00
United Zinc	N. Y. Curb			*55		
Yellow Pine	Los Angeles	*30	*30	*30	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1	1⅛		
Argonaut	Toronto	*34	*28	*33½		
Barry-Hollinger	Toronto	1.27	1.11	1.15		
Con.W.Dome L.new.	Toronto	*14½	*12½	*12½		
Cresson Consol. G.	N. Y. Curb	2	1⅞	2	Se. 30, Oc.10 Q	0.10
Dome Mines	New York	14½	12½	13⅜	De.30, Ja.20 Q	0.25
Golden Cycle	Colo.Springs	†1.74	†1.71		No.30, De.10 Q	0.04
Hollinger Consol.	Toronto	17.45	17.00	17.30	No. 16, De. 2	0.10
Homestake Mining	New York	74½	71	74½	De.20, De.27 M	0.50
Kirkland Lake	Toronto	2.58	2.40	2.45		
Lake Shore	Toronto	26.81	26.35	26.35	De.1, De.15 QX	0.20
McIntyre-Porcupine	New York			25⅜	De.1, De.1 Q	0.16
Portland	Colo.Springs	†*25	†*20		Ap.6, Ap.15, Q	0.02
Rand Mines	New York			48½	Au.22-29 Am.Sh.	1.52
Teck-Hughes	Toronto	10.45	9.85	10.45	Fe.1, X	0.15
Tom Reed	Los Angeles	*28	*25	*28	Dec., 1926	0.02
Tough-Oakes	Toronto	*76	*68	*69½		
United Eastern	N. Y. Curb	*45	*45	*45	July, 1924	0.05
Vipond Cons.	Toronto	*75	*70	*71½	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	6.67	6.00	6.10	Oc.17, No.1	0.05
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	16	12	16⅜		
Con. Cortez	N. Y. Curb			*17		
Dolores Esperanza	N. Y. Curb	*63	*50	*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2 5/16	2 3/16	2⅛	De. 15, Ja. 4	0.08
Tonopah Belmont	N. Y. Curb	1	1	1	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*12	*12	*12	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2	2	2	Se.20, Oc.21	0.07½
West End Consol.	N. Y. Curb	...	...	*4	Mar., 1923	0.05
Yukon Gold	Boston Curb	*75	*75	*75	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	2.12	1.95	2.00	May, 1920	0.03
Castle-Trethewey	Toronto	*83	*80	*80		
Coniagas	Toronto	4.86	4.50	4.75	May, 1924	0.12½
Keeley	Toronto	*75	*72	*72	Se.1, Se.15	0.08
Lorrain Trout Lake	Toronto	...	...	*60	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*19	*18½	*19	Oct., 1920	0.03
Mining Corp. Can.	Toronto.	4.10	3.80	3.82	Ja. 10, Ja. 25	1.50
Nipissing	N. Y. Curb	6⅞	6⅛	6⅛	De. 31, Ja.20 Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5	3⅛	3⅜	Ma. 25, Ap.4, QX	0.12½
Bingham Mines	Boston	61¼	56	61	Ja. 21, Fe. 1 Q	0.95
BunkerHill&Sullivan	N. Y. Curb	142	137½	140	No. 24, De. 5 X	0.75
Cardiff M. & M.	Salt Lake	*82	*66	*82	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	2.97½	2.75	2.95	Nov., 1926 Q	0.10
Consti'n Mng. & Mill'g	Spokane	*29	*28	*29		
Erupcion	Boston Curb	*60	*60	*60	De.17, Ja.2 Q	0.07½
Eureka Lily	Salt Lake	1.32½	1.17½	1.30		
Federal M. & S.	New York			145	Jn.25, Jn.29 Spec.	$10
Federal M. & S. pfd.	New York	95½	93¾	94	No. 12 De 15 Q	0.25
Hecla Mining	N. Y. Curb	16⅝	16⅜	16⅜	No.15, De.15 Q	1.75
Highland-Surprise	Spokane	*12¼	*11½	*12¼		
Iron King Mining	Salt Lake	*55	*50	*55		
Keystone Mining	Salt Lake	*22	*17	*17	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*26½	*26	*26		
Lucky Tiger-Com	Kansas City	†7 75	†7 25		De.10, De. 20 X	0.12
Mammoth Mining	Salt Lake	2.00	1.95	1.97½	Jn.10, Jn.20 Q	0.05
Marsh Mines	Spokane	1⅝	1½	1½		
North Lily	Salt Lake	3.70	3.40	3.67½		
Park Utah	New York	10½	7½	10	De. 15, Ja. 3 Q	0.20
Plutus Mining	Salt Lake			2.50	Oc. 25, No. 10 Q	0.10
San Rafael	San Fran.	*11½	*8	*8½		
Silver King Coal	Salt Lake	11.12½	10.50	11.00	De. 24, Ja.2 X	0.35
Silversmith	Spokane	*23½	*23	*23	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*48	*47	*47		
Sunshine M. Co.	Spokane	1.20	1.15	1.15		
Tamarack-Custer	Spokane	*50	*48½	*50	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.50	12.50	13.00	De.20, Ja.3 QX	0.40
Utah-Apex	Boston	5	4⅞	4⅞	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	59½	53¼	59	Se. 2, Oc. 1	1.75
Cleveland-Cliffs Iron	Cleveland	110	102¼	105	Oc. 15, Oc. 25 Q	1.00
Colorado Fuel & Iron	New York	83¼	79⅛	83	May, 1921	0.75
Gt. North'n Iron Ore	New York	24½	23⅝	24⅛	Dec. 6, Dec. 28	0.75
Inland Steel	New York	57½	54	56¾	No. 15, De. 1 Q	0.62½
Replogle Steel	New York			12⅝		
Republic I. & S.	New York	61½	57⅝	60⅛	No. 15, De. 1 Q	1.00
Republic I. & S. pfd.	New York	105	103¼	103⅜	De. 14, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	123¼	115	123½	De. 10, De. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York			110	De. 20, Ja.3 Q	1.75
U. S. Steel	New York	150	142⅝	148⅜	No. 30, De. 30 Q	1.75
U. S. Steel, pfd.	New York	138½	138	138½	Oc.30, No. 29 Q	1.75
Virginia I. C. & C.	New York	36	36	36	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York	....	....	60½	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	...	...	27½	Jn. 26, Jn.30	1.45
So. Am. G. & P. New.	N. Y. Curb	2½	2½	2½		
Alum. Co. of Amer.	N. Y. Curb	133⅜	127	128½		
Alum. Co. of Amer.pf.	N. Y. Curb	106⅜	104½	104½	Se. 15, Oc 1 Q	1.50
Vanadium Corp.	New York	59⅜	55½	58⅞	No. 1, No. 15 Q	0.75
Patino M. & E.	New York	23	22	22⅞	Ap. 27, My. 5	1 sh.
ASBESTOS						
Asbestos Corp.	Montreal	34¼	33	33⅛	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	96	94	94½	De.31, Ja.16 Q	1.75
SULPHUR						
Freeport, Texas	New York	106½	100	103½	Ja.14, Fe.1 QX	1.75
Texas Gulf	New York	79⅛	75⅝	76½	De. 1, De. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	48	41¼	47⅞	No.19, De.1 Q	0.75
Amer. Metal, pfd.	New York	...	...	110	No.19, De.1 Q	1.75
Amer. Sm. & Ref.	New York	176½	172¼	176¾	Oc.14, No. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	129	128⅝	128¾	No., Dec. Q	1.75
Consol. M. & S.	Montreal	271½	256	260	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	129⅞	123¾	127½	Se.30, Oc. 15 Q	1.00
U. S. Sm. R. & M.	New York	48⅛	45½	46¾	Oc. 6, Oc. 15 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	51½	50¾	51½	Oc. 6, Oc. 15 Q	0.87½

* Cents per share. † Bid or asked. Q. Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED DEC. 6, 1927

Name	High	Low	Last	Date	Amount	Last Div.
Aramayo Mines (25 frs.)	75/—	72/—	75/—	Nov., 1927	5	p.c. (†)
British Platinum (£1)	—/3	—/3	—/3	Feb., 1925	2½	p.c.
Burma Corpn. (10 rupees)	13 6	12/9	13/6	Aug., 1927	6	annas*
Bwana M'Kubwa (5s)	4/3	3/4½	4/3			
Camp Bird (2s)	3/3	2/10½	3/—			
El Oro (£1)	3/4½	2/10½	3/3	Nov., 1924	2½	p.c.*
Esperanza (10s)	—/2	—/2	—/2			
Frontino & Bolivia (£1)	14/3	14/—	14/—	July, 1927	5	p.c
Mexican Corpn. (£1)	8/—	7/6	8/—			
Mexico Mines of El Oro (£1)	16/3	13/9	16/3	Dec., 1926	3½	p.c.*
N'Changa Copper Mining	15/—	12/6	14/—			
Oroville Dredging (£1)	5/3	4/6	5/—	Dec., 1923	3½	p.c.
Ouro Preto (£1)	2/6	2/—	2/6	May, 1925	2½	p.c.
Rhodesian Congo Border (£1)	35/—	32/6	35/—			
St. John del Rey (£1)	10/6	9/9	10 6	May, 1927	3½	p.c.
San Francisco Mines (10s)	28/6	27/—	28/6	July, 1927	15s.	
Santa Gertrudis (£1)	17/3	16/3	17/—	July, 1927	7½	p.c
Selukwe (2s. 6d.)	7/6	7/—	7/4½	April, 1917	6¼	p.c
S. Amer. Copper (2s.)	2/3	—/9	1/—	Nov., 1917	75	p.c
Tanganyika (£1)	67/1	62/6	65 —	Aug., 1927	7½	p.c
Union Miniere du Haut-Katanga (Brussels)	10.850	10.125	10.850	July, 1927	182.60	(‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.

Industrial Progress

Wet Stoper Designed to Permit Repair of Water Tube at Face

THE importance of designing and building a rock drill so that it can be kept underground without being taken to the surface for repairs is appreciated by every mine foreman and superintendent. Time out for a machine is bound to mean money out for the company using it. Not only does the lost drilling time enter into this loss but the cost of carrying the drill to the station, up the shaft and to the shop likewise enters, as well as the cost of the repairs that have to be made. If therefore a machine can be so constructed that the repairs most likely to be required can be made directly at the working face, a considerable saving will be effected.

The wet stoper shown here in two views is so designed that the water tube may be renewed directly at the face, thus making a trip to the shop unnecessary. The cut at the right shows the machine in the upright, tube-removing position

With wet stoping drills the repair most likely to be needed is the cleaning out or the renewal of the water tube. Ordinarily it is necessary to take the machine apart to do this, which requires a trip to the shop. One manufacturer, however, has recently introduced a model with which this loss of time and money is eliminated. To remove the water tube from this machine it is only necessary to slack off two nuts, turn the feed cylinder to one side, and remove the water tube plug, whereupon the water tube drops out. This can be done directly at the working face. The drill referred to is the No. 4 model of the Cochise Rock Drill Manufacturing Company of Los Angeles. The improvement described has been covered by a patent that has just been issued.

The drill is built entirely of forged steel, the valve block, feed-cylinder collar, pivot bolt and swing bolt being drop-forged. The cylinder chuck and other ordinary parts are, of course, drop-forged and hardened. Thus adequate strength is assured.

Other improvements, likewise covered by recent patents, have also been made in the new model. The air which is supplied to the feed cylinder is passed through a port in the hinge bolt. Because of this, in changing or repairing the water tube, no attention need be paid to dust or dirt that may collect on the exposed faces of the joint between the feed cylinder and throttle block, for an air-tight joint at this location is not imperative.

It is possible in the new model to control the feed of the machine while drilling or starting a hole. This is done by means of a push button which actuates a plunger so as to cut off or regulate the air supply to the feed cylinder. The button is on the collar of the feed cylinder, just below the throttle handle where it cannot be readily injured.

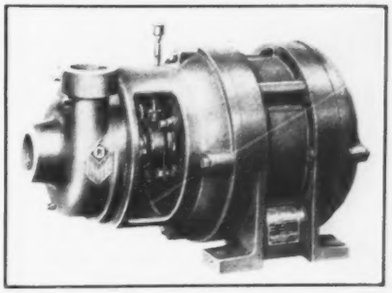
The machine is comparatively light, weighing only 76 lb., and is likewise compact and well-balanced. This combined with a long feed and a short overall length adds to its efficiency. The hammer has a rated speed of 2,500 uncushioned blows a minute. Power is saved by cutting the air off early at each end of the stroke, which allows it to expand in the cylinder before exhausting.

A reservoir for oil is formed by boring out the rotation handle. Whenever the throttle is turned, oil from this chamber mixes with the air and is distributed through the drill, insuring uniform lubrication.

A Compact Pumping Unit

The accompanying cut shows one of the type SSU centrifugal pumping units recently brought out by the Allis-Chalmers company. These combined motor and pump units are of simple, compact, substantial design, the complete units being not much larger than a motor alone.

Both the pump and motor parts are built and guaranteed by the same manufacturer, so there is no divided responsibility and the pump and motor ends are properly proportioned to work together as an efficient, reliable unit. The unit is close-coupled by fastening the pump impeller to one end of the extended motor shaft, which is of ample diameter. The pump casing is bolted to a special integrally cast extension of one of the motor end housings. This makes the simplest possible construction and eliminates a base plate, coupling, and pump bearings and does away with the possibility of misalignment between the pump and motor. The motor bearings, which are the pump bearings as well, are oversize Timken tapered roller bearings, having ample thrust and radial capacity, and are mounted in dust and grease-tight housings. These bearings have practically negligible wear, carry the



A 2x2-in. single stage centrifugal pump mounted on the extended shaft of a 3-hp., 3,500-r.p.m. squirrel cage induction motor with roller bearing. The pump is bolted to the motor housing

thrust of the pump impeller and need only infrequent renewal of the lubricant.

The pumps are built in 1¼x1¼ in.; 1½x1½ in.; 2x2 in., and 2½x2½ in. sizes and can be used with 1, 1½, 2, 3, 5, and 7½-hp. motors. The capacities handled range from 25 to 200 g.p.m. against heads of from 50 to 100 ft. These units are very efficient and have many applications within their capacity head range.

Regulates Flow of Gas for Welding

A ball-bearing gas regulator for welding work has been designed by the Smith Welding Equipment Corporation, of Minneapolis. It is equipped with a reinforced vulcanized rubber diaphragm, 4 in. in diameter. This is not fastened to any operating part. It is durable and cannot warp or crack.

The diameter of the gas passage in the nozzle differs in the oxygen and fuel gas regulators so that ample volume of gas, accurately regulated, is always had. The seat is mounted in a ball-bearing guide. This insures frictionless movement and perfect seating. The operating mechanism is free, positive and quick in action. It is unaffected by weather or temperature conditions. This combination of an instantly responsive diaphragm, a frictionless mechanism and proper size opening in nozzle are advantageous, the maker asserts.

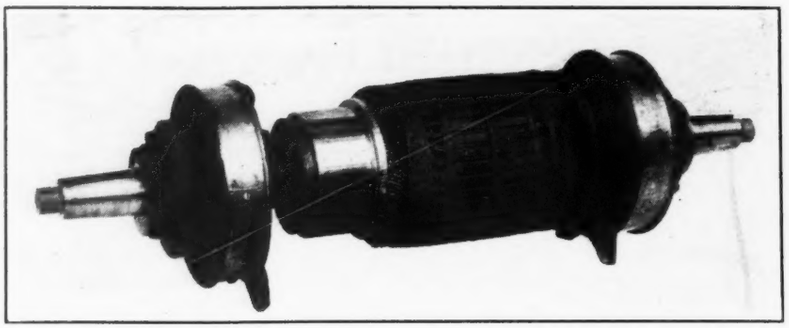
Steam Dumper Electrified

The Pittsburgh & Conneaut Dock Company's car dumper at Conneaut, Ohio, which was the fastest steam-driven dumper on the Great Lakes, is now electrified, being the second electrically operated car dumper to go into service on the Lakes. In addition, this is the first electrification in this country of a steam-driven car dumper of the lifting type.

The change to electric drive took place in June. Just 14 hours after the steam engines had been shut down, coal handling was resumed. The dumper is a McMyler-Interstate machine with a capacity for unloading cars carrying up to 100 tons of coal.

The electric equipment (General Electric) includes a motor-generator set, operating motors, and suitable control. The motor-generator set is rated 1,125 kw. and is of the four-unit type, changing the alternating current supply to direct current at the proper voltages.

The dumper cradle is driven by two 450-hp., shunt-wound, mill-type motors governed by the variable-voltage Ward Leonard method of control either from the "mule" operator's house or the chute operator's house. Suitable protection is provided, in the form of a transfer switch, to prevent the operation of the cradle from more than one point at a time. The "mule" is driven by a single 450-hp., shunt-wound, mill-type motor controlled from the "mule" operator's house by the variable-voltage method.



The armature of the new power shovel motor. Note the feet on the bearing housings. These keep it from rolling

New Motor for Power Shovels Conforms to A.I.E.E. Standards

PRIOR to the development of its new MD and MDS motors, which were placed on a production basis during the past year, the General Electric Company found it necessary to use a steel mill motor in equipping power shovels. The new series of motors (which are covered in the company's bulletin GEA-714) offer several advantages for power operation. They are also intended for steel mill work and for cranes and hoists.

The principle feature of the design of this motor is the reduction of the WR^2 factor which facilitates rapid acceleration. Designed in collaboration with the standards committee of the American Intstitute of Iron and Steel Electric Engineers, the new motors fully meet the specifications of that body and are the first motors on the market to conform with them.

The outstanding qualities of these shovel motors are summarized by the maker as follows:

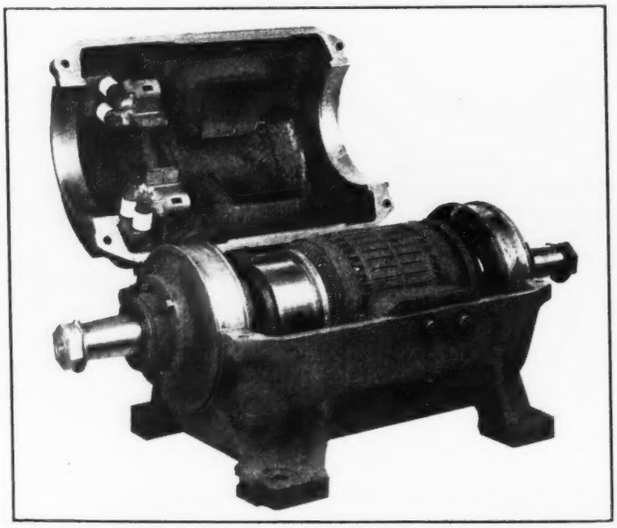
1. Heating-resisting insulation (mica and asbestos) conforming to A.I.E.E. Class "B" insulation specifications.
2. Ability to commutate high overloads.
3. Very low WR^2 to permit exceedingly rapid acceleration and frequent reversals.
4. Ready accessibility of each part.
5. Great mechanical strength of individual parts and exceptional security of the whole structure.

The motors are of the roller bearing type, in compliance with the standardization rules. The roller bearings will be used as standard, although sleeve bearings can be supplied if desired.

The new line involves improved mechanical construction, more efficient use of materials and a refinement of details, when compared with the superseded line of MD-100 motors. A greater adaptability to severe service conditions is also claimed. Parts are more accessible and, at the same time, are better protected. The bearing construction for either sleeve or roller bearings incorporates new features.

For Pulling Fuses

An interesting tool, combining in itself the function of a fuse puller and screwdriver, has recently been introduced by the Trico Fuse Manufacturing Company, of Milwaukee. The tool is made of horn fiber, and is 5 in. long. One end has jaws for gripping small cartridge fuses ¼ to ½ in. in diameter. At the other end there is a screwdriver.



The new motor for power shovels shown with its cover raised. The armature may be lifted out.